

## **Towards assessing the impact of circadian lighting in elderly housing from a holistic perspective**

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# ARCH17

3RD INTERNATIONAL CONFERENCE  
ON ARCHITECTURE, RESEARCH, CARE AND HEALTH

**CONFERENCE PROCEEDINGS**

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Nanet Mathiasen (Ed.)  
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# Preface

Welcome to the international conference ARCH17 – Research, Care and Health in Copenhagen.

We, the Research Group for Universal Design at the Danish Building Research Institute, Aalborg University Copenhagen are delighted to host this conference, the third in the series that in 2012 was hosted at Chalmers University in Gothenburg, Sweden and in 2014 at Aalto University in Espoo, Finland.

The aim of the conference series is to offer an insight into knowledge and research leading towards new understanding of the potential of healing architecture, focusing specifically on the issues of health, care and architecture. Though still in its consolidation in the Nordic countries, this field of research presents important knowledge for the current large investments in healthcare infrastructure in all the Nordic countries.

Research on health in architecture is a growing field that inherently is interdisciplinary, drawing on knowledge from medicine, nursing, gerontology, architecture and environmental psychology in order to understand the complex interaction between healthcare and architecture; how does architecture support the practices of healthcare?; how does architecture impact the wellbeing of patients and staff?; and can architecture enhance physical activity? This decisive interdisciplinary approach to this new emerging field of research is also mirrored in the program of this conference.

The theme of ARCH17 – Research, Care and Health introduces *universal de-sign*, as universal design and healing architecture are overlapping fields on many levels, and in particular in their focus on the relationship between human scale, well-being and architectural space. Universal design considers all users as target user by recognizing the diversity represented, when the user needs are considered in a life time perspective with changing and diverse needs and preferences through lifespan and living situation. The aim of universal design is to accommodate for this diversity through an inclusive architecture. This means that universal design also is interdisciplinary in its essence in order to understand the user, the needs and the practices of both individuals and building professionals.

It is the hope of the organisers of this conference that these two fields of research can inspire each other mutually and strengthen the network and experiences that each of the fields represent.

We will like to thank Realdania and Knud Højgaards foundation heartily for their funding of the conference.

We wish you an enjoyable, fruitful and inspiring conference.

*Anne Kathrine Frandsen*, Senior researcher, SBi AAU and  
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# Building up/on evidence, Healthcare Architecture Research in the Nordic countries

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## Challenges

Research on Healthcare Architecture is a developing research field that has established itself internationally during the last decades of the 20th century. In the Nordic countries it is still scattered and in a phase of consolidation. The issue of how the built environment is integrated in healthcare systems and processes is of importance due to a number of challenges that affect several organisations, institutions and governments involved in healthcare delivery. This changing context of healthcare delivery includes ongoing changes in the demographic landscape, a growing population living with chronic conditions, development in medical technology and treatment of patients, as well as political and economic pressures upon healthcare programs.

In the Nordic countries, having publicly tax financed healthcare systems of high quality with equal access for all citizens, it is not feasible to deal with rising costs simply with higher taxes. Given the current budget constraints, health expenditures are under strong pressure and in this way pushing healthcare organisations to provide high quality healthcare cost effectively and to make fundamental reforms in the way in which they deliver healthcare. This requires, among other things, new approaches and solutions. Healthcare needs to be delivered in an environment that is socially and economically sustainable and this puts increased pressure on quality, innovation and performance, emphasising the need to do more with existing available resources. Furthermore it needs to take into account a person centred approach, issues related to efficiency, health promotion and a strong focus on patient and staff experiences and outcomes.

One of the developing challenges in the European countries for example is the raising demand for healthcare services, with at the same time a decreasing workforce of healthcare professionals. This is due to the fact that the health workforce itself is also aging, without sufficient new recruits to replace those that are retiring. Without further measures to meet these challenges, the European Commission estimates a potential shortfall of around 1 million healthcare workers by 2020 rising up to 2 million if long term care and ancillary professions are taken into account (EU, 2012, 2013, 2014).

An important part of managing these challenges are issues related to investments in hospital buildings and other healthcare infrastructure. Accordingly, all of the Nordic countries are now making large investments in healthcare environments. While there has been an increasing focus upon patient-centred care coordination, profoundly questioning the system and organisation of service structures, the built environment remains an essential factor highlighting its potential to support health and wellbeing.

In addition, society is also facing major challenges when it comes to the growing need for healthcare integrated in ordinary housing. The fact that healthcare moves increasingly from the hospital building to the home, brings new demands and needs of a supportive environment outside the traditional care settings, which also places new demands on urban planning and the design of neighbourhoods and houses. In light of the increased transfer of care from inpatient to primary and community care, the municipalities are also confronted with sicker patients, new groups of patients, increasingly technologically advanced medical care and a greater turnover of patients.

All these challenges related to healthcare delivery in combination with growing demand of a supportive design of healthcare facilities and inclusion of the daily residential environment, emphasises the need to increase

research on the relationships between built environment, wellbeing and health outcomes. ARCH17 therefore aims to contribute and offer an insight into research focusing specifically on the intersection between health, healthcare delivery and built environment as a field of research that aims not only to improve the quality of buildings but also their effects on wellbeing and health.

## Themes of the arch17 conference

### **Body and Built Environment**

The built environment is an essential factor in the healthcare coordination and yet an essential projection of caring environments that affects better health and wellbeing. This includes mediating phenomena such as indoor climate represented by daylight penetration, acoustics, art, colours and pleasant views; as well as access to the outdoor spaces. Both Evidence-Based Design (predominantly used in a health context) and universal design (in the context of disability) address these various contextual factors in relations to the diverse health conditions, abilities and experiences of individuals as social beings.

### **Users and design methods**

Contemporary approaches to healthcare delivery put emphasis on patient-centred care coordination and therefore looks much more holistically at social and healthcare service structures. Healthcare is seen across multiple healthcare settings throughout the continuum of care: primary care, hospital care and post-acute care, including the provision and management of palliative care and hospice. Hence a healthcare delivery model must, ideally, provide the needed care where and when it is required by the patient and family, empowering as such these end-users of care services. The design of the healthcare environment has an essential role to fulfil, in order to spatially accommodate this turn towards patient- and family- centeredness. These process-orientated research and design methods include stakeholders and users in various ways and stages.

### **Societal changes and healthcare policy**

Healthcare architecture has a large impact on the environment in which, service providers such as caregivers have an essential role in realising inclusive and resilient societies. This is inevitably a matter of politics and economy. The healthcare reform – involving changing models of care, care service strategy, physical transformations of care facilities – is increasingly complex and includes many stakeholders that have to be involved. Relating to the built environment, these reforms should be looked at in a longitudinal perspective, i.e. understanding the need for adaptability and flexibility.

# Research in Healthcare Architecture

Research on healthcare architecture cannot be reduced to cover the buildings, premises and outside environment. It requires an understanding of the interaction between patients and healthcare professionals (people); the organisation of healthcare delivery (process) and the design of the architectural setting (place). This must all be seen in its context to increase understanding of how the various parts and the contents of the environment affect each other. Therefore, the design of healthcare environments needs to be addressed in a new way, not framed by the traditional construction processes, but in a process where the healthcare environment is in tune with the activities taking place in the buildings, based on a greater degree of evidence-based knowledge.

Nightingale (1876) already argued that health occurs inside the human being and that healthcare ought to create the best conditions for this. From the patient's and family's perspective, the focus on a person-centred approach should be based on the uniqueness of each human being and the knowledge that the experience of illness and impairments are different. A person-centred care activates the involvement of the person and his or her expectations by incorporating the person's life story and let it serve as a basis for planning the physical environment, which is an important factor in rehabilitation, recovery and wellbeing. However, the importance of health environment design that supports a person centred care is still surprisingly unexplored.

However, the recognition that the physical environmental design and supportive healthcare environments are an important part of a good healing environment has internationally been related to the development of practice and research on evidence-based design (EBD) and contributed to the development of it as a research field. EBD in healthcare has the objective that the design of the built environment must be based on the best available research on how the environment contributes to and affects health outcomes. Evidence-based design in healthcare encompasses about 2000 scientific studies showing that the qualities of the design of the physical environment, healthcare architecture, can help shorten period of care, improve patient safety, reduce contamination and increase the wellbeing of patients, relatives and staff (Ulrich 2012). A literature review on EBD (Ulrich, Zimring, Quan, Joseph, & Choudhary, 2004; Ulrich et al., 2008) found a growing body of rigorous studies to guide healthcare design, especially with respect to reducing frequency of hospital-acquired infections. As such, supportive healthcare environment contributes to efficient and safe healthcare, a safe working environment for staff as well as the patients' positive experience of care and attention.

An important starting point to understand the impact of the physical environment on healthcare delivery, wellbeing and health outcomes is the study of the interaction between healthcare and architecture and how it can promote health and wellbeing of patients and staff. There is a need to analyse the behaviour of patients and professionals, healthcare processes and architectural design in order to make healthcare service delivery more efficient by aligning healthcare processes to the utilisation possibilities of the building. For this a multidisciplinary approach is necessary that connects healthcare operational processes analysis, human behaviour analysis in the built environment and healthcare service planning of people (patients and professionals), process (diagnostics and treatments) and places (where patients receive treatment).



# Healthcare Architecture Research in the Nordic Countries

The research on Healthcare Architecture is inherently multidisciplinary. The research is conducted in several areas such as care sciences/nursing, architecture, landscape architecture, medicine and environmental psychology. This kind of research therefore often provides a meeting place for the complex and cross-border issues that modern healthcare is facing (Van Noorden, 2015). But its interdisciplinary character also means a risk to be outside of everyone's responsibility when it comes to research funding (Centrum för vårdens arkitektur, 2014). An overview of current research is needed in order to understand knowledge gaps, state of the art and to create an outset for further research and programs. A review of the current and previous ARCH conferences organised in the Nordic countries contributes to this overview and provides a platform for further development.

In 2012 the first ARCH12 conference was organised in Sweden, followed by the second ARCH14 conference in Finland and the third ARCH17 conference in Denmark. During these conferences a total of 70 papers on healthcare environment issues and healthcare architecture were presented, of which 11 from outside the Nordic countries. Reviewing all abstracts of these papers gives an overview of the research being conducted in the different research groups and universities across the Nordic countries. One of the first observations that can be drawn from looking at the basic statistics of this review is that most papers are written by the respectively organising countries. From all papers written by Nordic countries during these three conferences, 50% are based on research in Sweden.

	ALL	ARCH12	ARCH14	ARCH17
	COUNTRIES			
Sweden	29	16	7	6
Finland	16	3	11	2
Denmark	12	2		10
Norway	2			2
Other countries	11	(2) Netherlands Italy China	UK France Austria Namibia Japan	UK (2) Belgium Germany Australia
	RESEARCH AREAS			
architectural / urban design	52	18	13	21
psychology / nursing / medicine	10	2	3	5
process management and civil engineering	5	3	2	
university education	3	2		1
	INVOLVED RESEARCH DISCIPLINES			
1	50	16	12	22
2	16	9	5	2
3	4		1	3
4	1			1
healthcare institutions	15	2	7	6
contribution to papers	11	2	4	5

Almost 50 of the 70 studies reported in the papers were conducted in the research area of architectural and urban design; 10 were conducted in the research area of social and medical sciences like (environmental) psychology, nursing sciences, psychiatry and medicine; 5 papers had a focus on process management or civil engineering and; 3 papers relate to education at universities, both in architecture (how to teach student healthcare architecture design) as the university hospital as learning environment for healthcare professional students. However, looking at the number of involved disciplines per paper, 50 of the 70 papers were written within one discipline and only 11 papers had a co-author coming from a healthcare institution.

Half part of all papers use a qualitative approach for the empirical basis of their research. Only 5 papers use a quantitative approach and 7 papers use a mixed method approach. Other used methods are: experiments (5), design (9) and simulation (1). In addition there were 8 theoretical papers based on literature reviews. Looking at the number of cases studied in these papers, two-thirds are based on a single-case study approach and only 8 papers use more than 3 cases for their empirical research.

	ALL	ARCH12	ARCH14	ARCH17
	COUNTRIES			
	MAIN RESEARCH METHOD			
literature	8	3	2	3
qualitative	35	14	7	14
quantitative	5	1	1	3
mixed methods	7	2	3	2
experiment	5	3		2
design	9	2	4	3
simulation	1	0	1	
	NUMBER OF CASES			
theoretical papers < 1	8	2	4	2
1	44	14	11	19
2	4	2	1	1
3	6	4		2
papers, cases > 3	8	5	10	4
		7	14	5
		11		6

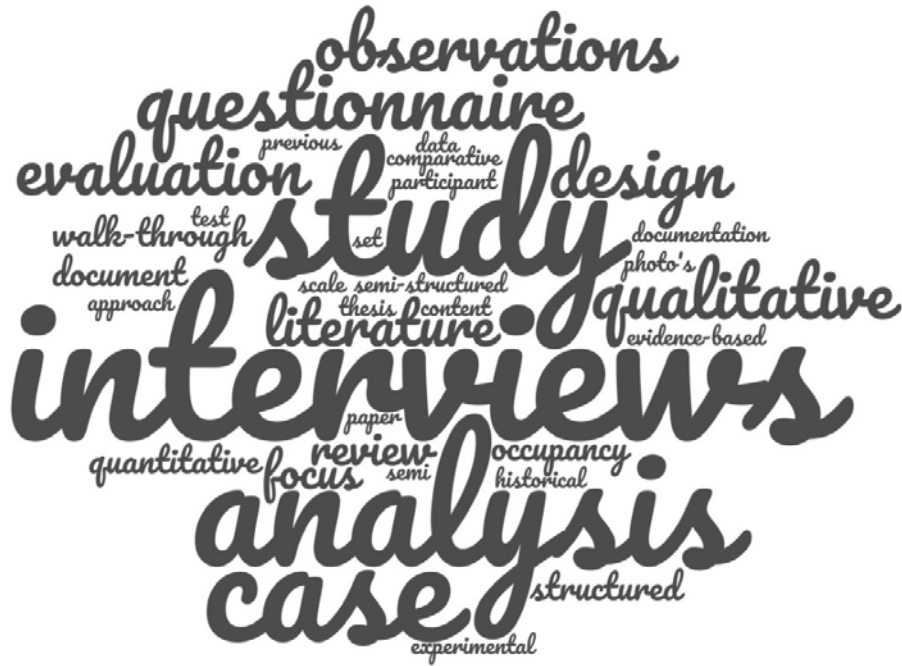
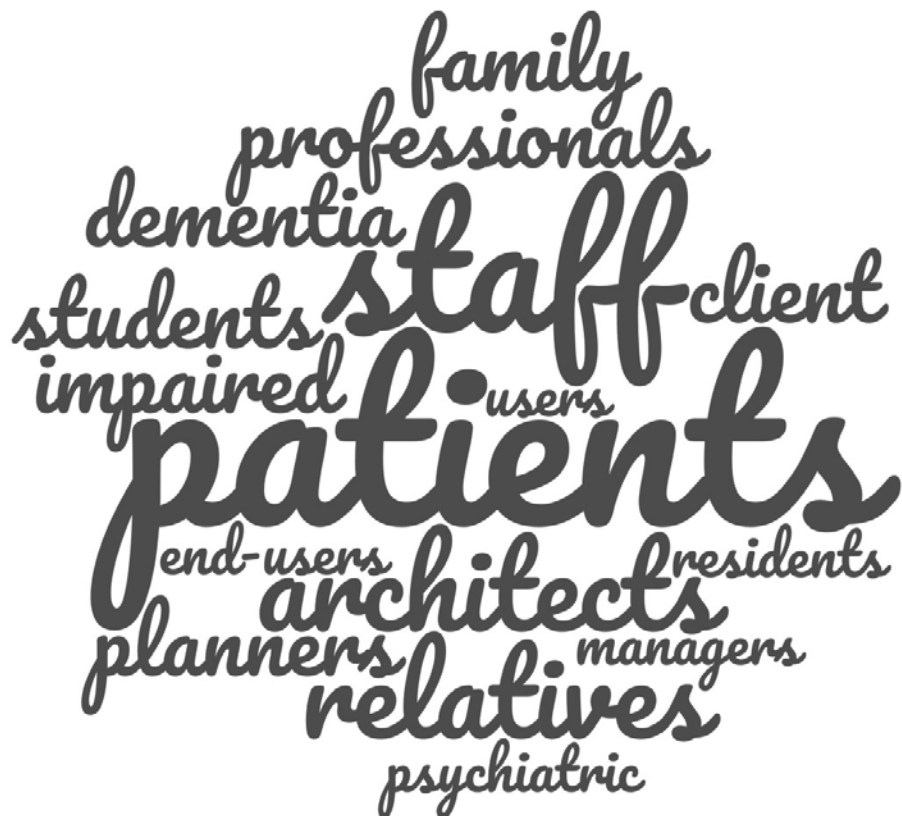


Figure 1 reviews the applied research methods in a word cloud, with more often used methods visible as larger words compared to less mentioned methods that are in a smaller size visible. This word cloud makes visible that interviews are the main source of data for analysis of case studies, followed by observations, questionnaires, design, literature and walk-through approaches. These methods emphasises the focus on qualitative research above other approaches. Figure 2 shows the main sources of data for the empirical research, according to the abstracts are (from mostly until less mentioned): patients, staff, relatives, architects, professionals, planners, students, clients, residents and managers.



Looking at the healthcare sectors that are being researched in these papers, a division can be made in: (a) healthcare in general (13 papers) : (b) hospital settings including psychiatric care (25 papers); (c) assisted living, including hospice and revalidation (13 papers) and; (d) residential living and universal

design (16 papers). This categorisation of healthcare architecture research in focus areas is used to go one step further in analysing the content of these research papers based on the review of abstracts.

	ALL	ARCH12	ARCH14	ARCH17
	HEALTHCARE SECTOR			
healthcare general	13	6	3	4
hospital	25	7	6	7
psychiatric hospital		1	1	3
rehabilitation centre	13	1	1	0
hospice				1
assisted living		5	3	2
residential living	16	4		5
universal design		1	2	4
other sectors			university laboratory	offices

# Focus Areas of Healthcare Architecture Research

## *(a) Papers with a focus on healthcare in general*

Main topics in this category involves quality in briefing, design process, user involvement and the impact on the architectural esthetical quality of the built environment in healthcare. Some papers have also a more theoretical perspective towards evidence-based design and how to integrate research in design processes. Main focus groups are administrators, client organisations and architects.

## *(b) Papers with a focus on hospital architecture*

This is the largest category of research with 25 papers during the three conferences. These papers can be sub-categorised into three groups. One sub-category of papers focusses on the quality of architectural design in hospitals and the way this quality can be evaluated and assessed by for example usability evaluation or post occupancy evaluations (POE). Another sub-category that can be identified looks at the impact of the design on the outcome for people, like wellbeing, injury, violence and disorientation. The last sub-category that can be recognised studies the impact of the design on the organisation of the care production process, workflow and optimisation of resources.

## *(c) Papers with a focus on assisted living*

This category can be defined as research within institutions that take care of people in a homelike situation, i.e. the usability as continuous negotiation between users and the physical environment that is both residential as well as a workplace for healthcare professionals. A typical example of research in this category is the quality of the physical environment and the impact of the architectural design on elderly with dementia. This includes for example visual pleasantness, social support, articulation of appropriate boundaries.

## *(d) Papers with a focus on residential housing and universal design*

The focus of research in this category is housing for elderly in their urban and social context, supporting health promoting activities and the possibility to live independently regardless of age, illness or disabilities. Therefore domestic activities, habitation and participation in society is studied. Besides typologies of residential housing and their functionality in daily use, some papers focus on practical functionalities, for example adequate lighting in houses in connection to contrast sensitivity of elderly with impaired vision.

A last category to be mentioned is that of papers with a focus on educational and work environments. These papers can be viewed as taking an activity or specific subject based perspective on healthcare buildings that is not directly rooted in clinical work. These papers are nevertheless relevant as most healthcare facilities are both a place for patients and work places for students and employees. This includes for example the hospital as learning environment for medical students, universal design of office spaces for employees with disabilities and the use of shared laboratory spaces in hospitals.



# Conclusion

Awareness of the importance of the environment for the health and wellbeing is high on the agenda within the research community on healthcare architecture. This is evident from looking at the large number of papers that have been produced over the years from both nursing research and architectural design research, but also visible in the established research centres where research and education in design and creation process of healthcare environments has a strong focus. Research in this field aims to fill the knowledge gap regarding the complex interactions between the patient's quality of life, person-centred care and the design of health care facilities. However, when it comes to describing and comparing the current situation of research in, what here is called; the field of Healthcare Architecture, the Nordic countries respectively have taken on different approaches and their status in their academic systems today are diverse. This reflects their differences in their history of both healthcare systems and research funding systems as well as the approach to healthcare environments in the construction processes affecting and forming clients, architects and contractor roles and responsibilities. These scattered approaches and lack of national programs for research on healthcare built environments imply that investments in healthcare facilities still can be considered to have a weak scientific base for project and design decisions. In the current situation with large investments this may lead to facilities that do not support efficiency and, especially, do not deliver satisfactory and supportive environments for patients and staff.

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# Housing for elderly in a changing social and health care service structure

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## Abstract

*In Finland the social and health care sector is undergoing major changes. The percentage of elderly population is growing due to longevity and low birth rates. Twice as many elderly need to be taken care of with the current amount of human and economic resources. New housing options to better support elderly and their family members have to be developed.*

*The aim of the ongoing project is to develop a new model of a service block, with integrated care and housing. Pilot projects are developed in different size municipalities with several stakeholders. Local housing options are studied with attention to the user empowerment. Master level students in architecture will do their thesis in ten of the municipalities. The result of the project is a vision and a new model of elderly housing. The model will adapt to different size municipalities and will promote efficient use of existing infrastructure. It takes into account future resources and trends developed together with the stakeholders. The physical, psychological and social rehabilitation of the resident is a key concept in the model. It will also address the financial sustainability.*

*The results of the project will improve the knowledge base of housing for elderly people. The service block model will be situated in centre of the municipalities near services and public transportation. The project will enhance the social wellbeing and integration of elderly in the society. It will provide the municipalities tools to develop their planning and concrete building projects. It will have societal impact nationally.*

*Keywords: elderly housing, municipalities, service block, inclusion.*

# Introduction

The population is aging globally. In Finland the dependency ratio of population (working age people compared to young and old) is growing fast. Especially number of very old persons is increasing rapidly. In Finland, by 2050 the number of persons 85 years and over is predicted to grow from 140 000 persons (2015) to approximately 390 000 persons (OSF, 2015). Twice as many elderly have to be taken care of with the current amount of human and economic resources. The aim is to increase home care for elderly in order to enable people live in their own homes as long as possible. Many elderly live in apartments that do not support their independent coping, however. Long distances or obstacles in the immediate surroundings may hinder to access daily services may be obstacle to live at home. This paper is describing a research and development project *Changing society – changing services*, which is carried out in collaboration with Aalto University and twenty different stakeholders in elderly care in different municipalities or health care districts in Finland.

The Finnish elderly care structure has in principle three levels of housing: 1) living at home or in a senior housing with home care, 2) living in an ordinary sheltered home or a sheltered home with 24-hour assistance or 3) living in long-term care institution. The care at home is the first option and institutional long-term care is only considered for a short period if medically justified (MSAH, 2013). The amount of people living in ordinary sheltered homes is decreasing as care is moving to home. On the other hand, the number of persons living in extra care sheltered homes with 24-hours care and in group homes is increasing (Väyrynen and Kuronen, 2015).

The home environment does not always enable an elderly person to live independently. Many old apartment buildings and single-family houses have obstacles and are not easily adapted to elderly persons (Verma et al. 2012). Moving to a more suitable apartment in the same neighborhood may be an option. Moreover, many elderly in good physical condition wish to move to an ordinary sheltered home because of feeling of loneliness and insecurity. To diminish the need of purpose built establishments for elderly, new housing options that offer possibilities for participation and inclusion can be developed at local level. A network of shared spaces in an accessible living environment can promote independent coping. The local networks of different associations and resident groups can be seen as part of social network that decrease loneliness and promote wellbeing (Aaltonen and Vauramo, 2016).

The physical and social environment can promote the inclusion of elderly in the society. The WHO (2007) considers for example housing, public transportation and access to services basic features of Age-friendly city. Accessible apartments, low threshold social and health care services in the neighborhood, as well as support of social contacts promote independent living and feeling of security at old age. The densification of city centers and refurbishment of central areas of small municipalities need to take into consideration the demographic change. The access to services and to the built environment enhance the participation and inclusion of elderly people to the society.

The result of the research and development project is a model of local center, that include housing and services for elderly people, called here a *Service block*. During the ongoing project, a service block model is developed through case studies in collaboration with different municipalities. The model is adaptable to municipalities of different size. The municipalities are in charge of providing housing for the elderly. The goal is to provide an efficient service structure for frail elderly living in their own accessible apartment in the center of the municipality.

## Aim

The ongoing research and development project *Changing society – changing services* aims at developing municipality centers of different sizes for aging population. The aim is to study new housing models for elderly in the Finnish context, through collaboration with local municipalities and academic researchers. Local environment, infrastructure and services are bases for the development. The aim is to produce a *Service block* model that take into account the current local context: existing services and housing provision suitable for elderly. The service block provides housing for frail elderly and aims at shared spaces in the use of public, private and third sector service providers in municipality centers.



# Method

The service block model is developed using multiple case study method. The case study method enables to study contemporary phenomenon in a real-life context (Yin, 1994). The project is carried on in a consortium with approximately twenty partners. The consortium consist of academic researchers and professors as well as relevant partners in municipalities and health care districts. Nine of the municipalities involved have a concrete building project, a pilot case. The multiple cases enable to observe and to reveal complementary aspects of the current challenges of different municipalities. Both qualitative aspects of buildings and quantitative data on population structure are used in the study. Moreover, thematic workgroups focus on health care structure, rehabilitation of elderly and the physical service block model.

The case projects are developed in different size municipalities in collaboration with local stakeholders. The cases are related to refurbishment of old premises (municipalities of Raisio and Vantaa), development of new aging friendly housing areas (cities of Rauma, Porvoo) as well as the combination of the two (Helsinki, Vantaa: Betesda Foundation). The walking friendly urban centers are developed in small municipalities (municipalities of Lapinjärvi and Ivalo) as well as in the district of big cities (Tesoma in the city of Tampere). Nine students of architecture, landscape architecture and urban planning do their final master thesis, each for one of the municipalities. The architectural design process is a tool to further develop the service block model, adjustable to different size municipalities.

Table 1. The municipalities with concrete case projects and number of inhabitants

Municipality /sub center of city	number of inhabitants
Helsinki / Vuosaari district	630 500 / 37 000
Tampere/ Tesoma area	230 000 / 20 000
Vantaa / Simonkylä area	220 000 / 7 800
Vantaa / Myyrmäki	220 000/ 16 000
Porvoo	50 100
Raisio	24 300
Rauma	39 500
Ivalo	3 000
Lapinjärvi	2 800

# Background

The demographic development is affecting the economical and human resources of the municipalities. The future needs for the aging population are related to age friendly services, walking friendly environment and housing for the elderly. The physical and social activities and rehabilitation are seen as integral part of daily living environment of elderly persons. The accessibility and walking friendly environment promote physical functioning capacities. Moreover, low threshold services, hobbies and activities enhance social contacts and inclusion. There is a need to create a platform for the various services and social activities that take place in the neighbourhood. It will enhance possibility to remain living in the community, even with restricted mobility (Smith, 2009). Furthermore, the quality of the built environment targeted for elderly residents has to be evaluated not only for the technical performance but also for the user satisfaction.

The old premises targeted to elderly do not meet the current standards of living. For example assessment of 56 buildings in Northern Karelia (Kekäläinen, Taegen and Vauramo, 2016) as part of the current project, revealed that only one third of the existing elderly care buildings were satisfying both technical and user needs. One third of them were fulfilling technical requirements for care buildings. They may be refurbished quite easily to satisfy current demands for care and housing. However, one third of the existing buildings did not satisfy the technical nor the user needs. The negative aspects of the existing buildings were related to the lack of spaces for rehabilitation and institutional layout: small rooms and long corridors. Moreover, the remote location of the buildings left the residents isolated and the premises inaccessible.

Many small municipalities are struggling with decreasing economical and human resources. However, the effective use of existing resources, both infrastructure and services, may bring new opportunities for economically sustainable development. Furthermore, the new model need to be based on the efficient use of the available resources in local context. Networking between the public, private and third sector and shared use of resources produce synergies to service providers and diverse services for the residents (Verma et. al 2017).

# Results

The main design criteria for a *service block* for elderly is the central location and easy accessibility. A new hybrid building with services and housing may complement the existing urban tissue. Furthermore, a service block can be a network of existing services and housing, a village like development. In both cases, the model requires a coordinator, who operates the network of local stakeholders and the spaces they require. The service block can offer accessible apartments for seniors and for frail elderly. It may also comprise extra care sheltered housing or group housing for the people with dementia. The housing developers can be private building companies or social housing organizations. Moreover, the service block can offer mixed housing possibilities: owner-occupied, right of occupancy as well as rental apartments. It can be a separate new building or a network of existing and new facilities in shared use.

## Hybrid construction

The architectural typology of the service block can be a vertical tower with services and apartments in different levels of the building. In urban centre the service block is situated near public transportation and other services, to create a mutual benefit of the new and existing service provision. Shared spaces and social activities are targeted to all residents in the neighborhood level. It can provide a living room for local residents of all ages.

For example in the case of Helsinki (fig. 1), housing services for people with dementia are planned near the metro station, next to a shopping centre and social-and health care centre. The location provides synergies for delivering health care services for the residents with multiple conditions. Moreover, the location enable friends and relatives to visit more often. It also facilitates the commuting staff members using public transportation.

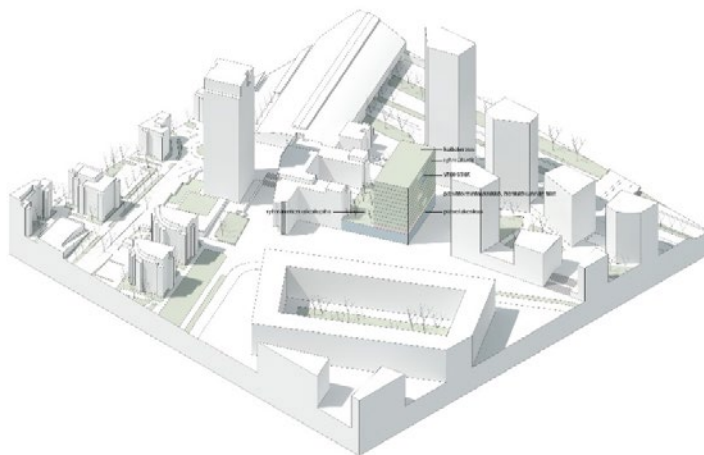


Fig.1. A vertical hybrid building with services and apartments on top of the other, Helsinki. (Rasilainen, K. student in architecture 2017)



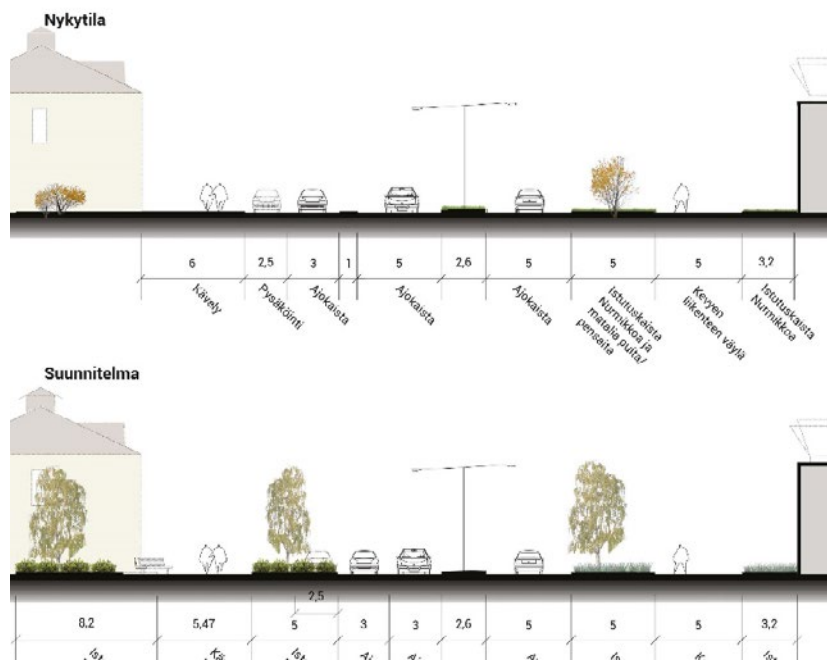


Figure. 3. The walking paths in the centre of the municipality: the current solution (above) and proposal to improve walking friendly environment (below). (Tenkanen, N. student in landscape architecture)

Lapinjärvi is a small municipality of approximately 2 800 residents. It is aiming to become the most resident friendly municipality in Finland. The municipality is aging rapidly but has an active and compact centralised service structure. The current sheltered home is situated within a walking distance from the commercial centre of the municipality. The community supports. Wayfinding and accessibility for pedestrians are developed in the centre of the municipality to enable also persons with Alzheimer's continue living in their own homes. Visual clues and landmarks along the walking path are planned to facilitate navigation. Moreover, for the elderly persons living in this rural environment small private houses are more attractive than apartment houses. Therefore, the densification of the centre with small-scale affordable private houses for aging population may be the solution (Ala-Karvia, 2016).

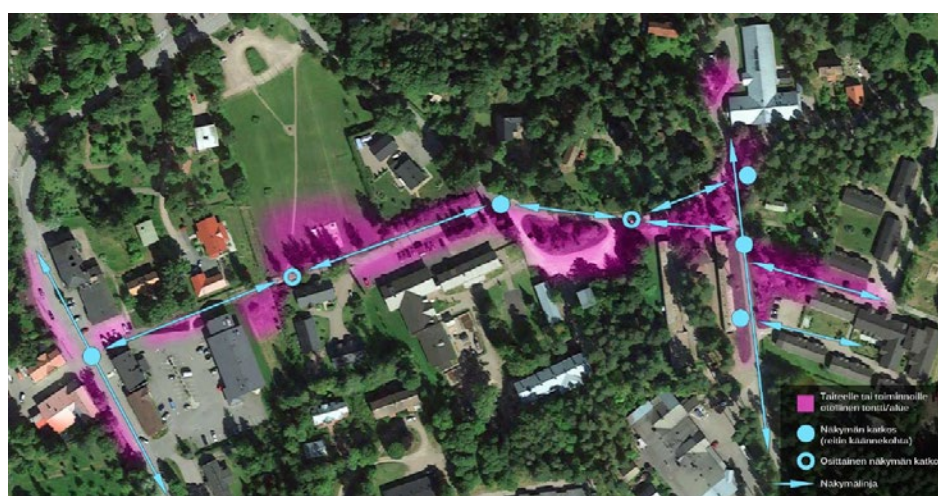


Fig. x. The pedestrian navigation and wayfinding is developed to connect the elderly care centre to the local daily services. (Ala-Karvia, J. landscape architect 2016)



## Densification of the urban structure

The municipality of Rauma is planning an extension of the urban area. New housing developments including apartments and services for elderly are planned in the perimeter of the center. Housing for persons with memory disorders and normal apartment buildings are planned on the same plot. Moreover, to anticipate the needs for future residents of all ages, a kinder garden, restaurant and cultural services are planned on the same area. Furthermore, a communal garden with urban farming and walking paths will be provided for the neighborhood.



Fig. x. In Rauma, new apartments for elderly and services for the whole neighbourhood are planned. (Jusslin, E. architect 2017)

In Vantaa City, the Simonkylä elderly centre will be renovated in near future. Discussion on the use of the old premises and future extension is going on. Moreover, some of the old buildings may reach technically end of life and therefore demolished. The aim is that the renovated premises will be in shared use by several local stakeholders. Organisations and associations can have their activities in the new and renovated premise. Elderly people living in the neighbourhood may organise themselves activities and hobbies in the centre. Moreover, service block would provide health and social care services to all people living in the neighbourhood. Therefore, the flexibility and openness of the architectural plan is important. The low threshold services and easy access will promote the multiuse of the premises.



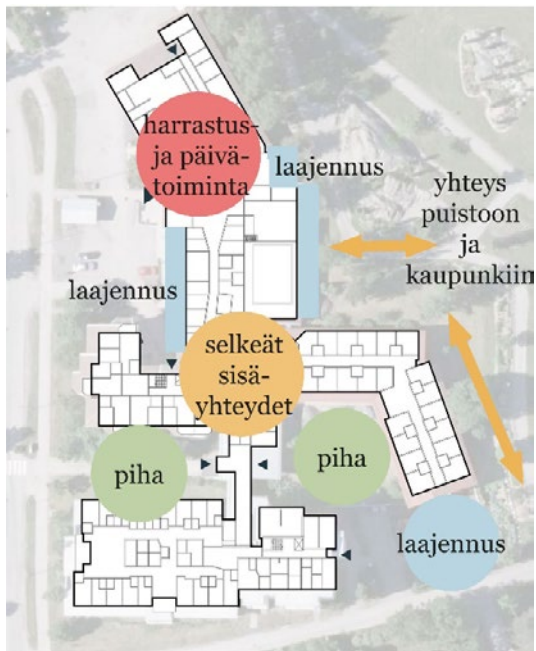


Fig. x. New entrances and green court yards (piha) around the building can be provided in the old building. Extension of the existing building (laajennus) in the south is possible (Tarkkanen, A. student of architecture)

The building of Betesda foundation in Vantaa, Myyrmäki will be renovated and partly demolished. The careful planning of the renovation process is important to assure the services even during the renovation period. New services (restaurant, recreational services, etc.) opening to the street will be provided for persons living in the neighbourhood.



Fig. x. Extension of the building towards the south with more public functions, (Virtanen, T. student in architecture)



The building is a platform for various services and social activities. Not only the technical performance but also the user experience of the building matter. The building should be inviting to users and make possible the shared use of premises of different stakeholders. New kind of co-ordination and contracting is needed to run the service block. The management of the premises and the services require knowledge of network management. Networking and collaboration with different sectors within the municipality require resources.

# Conclusion

To conclude, we define the service block as a flexible model to adapt services and apartments for elderly in the existing urban structure. The service block model is created as a network of various service providers using existing infrastructure. The service block can be developed and completed with new extensions to existing buildings. However, it can also be a new hybrid building. The bases of the model is to provide efficient services in shared spaces in a compact urban form. The central location is important for the accessibility as well as to create synergy between all stakeholders. Moreover, the service block need to be situated in the city centre near public transportation, so that a large number of residents can make use of it.

The architectural typology of a service block can be a tower, with services and apartments on top of the other. It can also take a village like form, with small-scale services and apartments. Moreover, the open plan should encourage physical and social activity of elderly persons residing in the building as well as people of all ages living in the neighbourhood. Walking friendly environment and easy access to the services is essential part of the plan.

The services are targeted to all people living in the neighbourhood. The physical, psychological and social rehabilitation of the resident is a key concept in the model. Service block can also provide extra care housing for people with Alzheimer's or other cognitive disease. This will ensure the inclusion of elderly people with severe disabilities. The service providers using the shared premises can be public, private or third sector organisations.

## Discussion

In order to manage the care of growing elderly population new solutions that combine housing and care are needed. In the current social and health care policy, the care at home is the primary option. However, many people are looking for accessible housing options in an environment that enhance their feeling of safety. The service block model provides accessible housing near daily services and home help when needed. The model addresses also the social and financial sustainability of the municipalities. The scale of the service block is defined by the local context. Collaboration with public and private service providers can create a sustainable local economy. The third sector and volunteers may contribute to the social networks of elderly.

# Acknowledgements

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# Promoting identity: Design strategies for an active ageing

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# ABSTRACT

*The relation between ageing process and domestic environment has been thoroughly addressed from Social Sciences and Architecture. In this context, identity is a fundamental aspect for the definition of home, but also for the enhancement of social and personal environmental conditions.*

*Identity relates to physical aspects of the built environment, domestic activities and routines developed by the user during the life course, as well as personal objects. Therefore, this paper aims to explain how architectural elements can promote and support personal enhancement and identity, promoting a better active ageing at home.*

*Three Danish examples of housing for the elderly included in this paper have been analysed with a specific qualitative method based on a multidisciplinary approach. This framework includes theories from social sciences and architecture in order to enhance age-related living conditions. Furthermore, empirical work based on visits, interviews and original documentation has been analysed through drawing, considering it as an essential tool in architectural research. Identity is associated to our capacity to transform the environment, to appropriate of the space. Therefore, in the conducted research, colonization performed by the users through personal objects were tracked in order to highlight its relation with the domestic space. There was a special concern about communication spaces, boundaries between the private and the common space and the relations between interior and exterior as representative places for users' performance and colonization.*

*Strandlund, Wiedergården and Nørre Søpark illustrate different strategies still in use, stressing how contemporary solutions have to be adapted to actual ageing challenges. A better flexibility in the programmatic architectural layout as well as in the individuals' self-expression is proposed for the enhancement of users' identity.*

*Keywords: Active ageing, Identity, Housing for the elderly, Users performance.*

# Introduction

What defines ageing is diversity. *People today not only grow older on average but also begin to age, physically and mentally, later than the elderly of past centuries. [...] they are in general healthier and more health conscious, more physically fit and mobile [...] they are more self-confident and participate more in social life. They are better educated and financially better off than previous generations* (Schenk, 2008). As any other social group, elderly are representatives of an increasingly individualized society, therefore housing solutions must address this complexity. In this context, Active Ageing concept establishes a common framework policy to ensure a successful ageing for everyone. WHO defines active ageing as:

*[...] the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age (WHO, 2002)*

This concept stress the importance of being active under a physical, social and mental well-being perspective. The word “active” is understood beyond the physical abilities, incorporating participation in a “social, economic, cultural, spiritual and civic” perspective. Thus, participation stands out as an essential notion highlighting the value of autonomy in making decisions, as well as empowerment of personal identity, for the improvement of ageing.

Active Ageing is the current stage of a large trend focused on the promotion of participation by empowering the elderly. It compiles different perspectives from Social Sciences, addressing the relation between the person and the environment (P-E). Ecological Theory of Ageing (Lawton & Nahemow, 1973), was the first one to establish a relation between the environmental press and personal competence during the ageing process. Subsequently, Successful Ageing (Rowe & Kahn, 1987, 1997) in relation with Selective-Optimization-Compensation Model, (Baltes & Baltes, 1990), moved from the importance of the environment to a more emphasis of personal capabilities. These theories have deeply influenced the existing policies on housing the elderly by enhancing social and personal life-conditions through more personalised and specialised services. The focus is centred on the individual, their necessities, demands and desires, through participation and being active (P-E-A).

In this context, personal identity becomes a fundamental aspect on the definition of home, as well as for the enhancement of social relations. But, how has this been incorporated to the architectural framework? To answer this question, this paper focuses on the architectural elements that promote and support personal enhancement; as well as, the way users colonize and perform within the built environment in order to express their own identity through personal objects.



# Theoretical framework

With the person-centred approach, individual understanding of home became an important topic for developing appropriate policies. The relation between person and domestic environment evolves during the life course, but it gets strongly challenged during the ageing process. Besides previously mentioned gerontological perspectives, it is also important to highlight sociological approaches focused on this P-E relation and how ageing affects our perception of “home”.

The concept of “home” is the result of a connection between the individual and their house. This relationship is established through transactions at the level of action or doing (engaging in activities, tasks, routines, rituals) and at the level of meaning or being (our sense of personal existence) wherein an individual evaluates, interprets, and assigns significance to their experiences within an environment (Werner et al., 1985). In essence, the definition of home relates both to functional and symbolic transactions from an individual perspective.

Rubinstein & Parmelee (Rubinstein & Parmelee, 1992) argument that time and space are also part of the definition of “home”. For these authors, sense of belonging is important for maintaining a permanent link to the past, but also as a secure place on the constant life changes. Rowles uses the concept “autobiographical insideness” (Rowles, 2000) to describe the relationship that develops over time, where a person becomes part of the place and the place becomes part of the person (Tanner et al. 2012). This bond develops continuity as a feeling based on symbolic meanings, but also as container of personal experiences, memories and objects.

For Rubinstein (Rubinstein, 1989), objects can also be an important component of the home. From a functional to a more personal reflection based on symbolic and emotional relationships. Objects have a strong capacity on revival past situations and can be the link between the past, present and future home. The absence of certain objects is associated with the absence of home.

In summary, activities, time and objects are the most important elements on the definition of “home”. Therefore, existing relations between them and the architectural realm have been studied in this research.

From the architectural perspective, there is a greater interest on the functional transactions linked to actions. There is a strong relation not only with the physical aspects of architectural design, but also with use of space or the activities performed in the domestic environment, including social network relations and daily routines. Rowles uses the concept “being-in-place” for describing these activities (Rowles, 2000). In this regard, architectural design can support a successful ageing by focusing on these activities, not only with adjustments on the physical aspects but also in the use of the space.

The study of these individuals’ routines within the private environment has been previously addressed in architecture. As a result of the incapacity of performing certain activities, daily habits among elderly are fundamental for the development of successful solutions. Percival (Percival, 2002) highlights the important connection between person and environment on the development of certain daily activities, specially those related to leisure, eating, resting and customization. In the course of time, individuals adjust

their comfort by altering the space, colour, light, ambient, etc... establishing an intimate relation with the physical characteristics of the home.

Time plays also an important role on the adjustment of daily activities to individuals' necessities and requests. Some authors distinguish between routines and events within the temporal context. Werner (Werner et al., 1985) identified cyclical and linear temporal aspects. Cyclical refers to those repetitive activities on a daily, weekly, monthly... basis. Linear refers to events over time, which establish a continuum between past, present and future. To lose control over these activities creates a strong disruption on the meaning of home and on self-expression.

Besides the personal notion of home, there is also a strong social component. Objects, routines and activities incorporate also relationships with other individuals. These relations are also influenced by our social and cultural context; thus, home becomes a representation of our social status. On the other hand, social participation enhances social skills during ageing. Therefore, most policies are focused on maintaining the existing social network to avoid social exclusion and loss of community meaning; the so-called "ageing in place".

Ageing process affects specially to those personal and social activities performed outside. Individuals can end up playing mainly an observer role, stressing the importance of an appropriate relation between domestic and public environment. Home becomes a secure place to stay and receive visits, compensating a less active life and allowing the elderly to stay connected to the community. As a consequence, limits between public-private and interior-exterior become fundamental during the ageing process. These limits have been deeply addressed by architects on the development of the different models for housing the elderly, existing a clear link between the sociological theories, focused on a person-centred approach, and the Modern Movement revision formulated by the Team X. During the 1960's existing housing models were revisited from an architectural, philosophical and sociological perspective: the approach switched for a better inclusion of individuals' characteristics and the enhancement of social relations.

For the Team X, the solution was the "Space Between". For Allison and Peter Smithson, this concept was related to the threshold as a transition between the street and home. For Van Eyck, the meaning of Space Between incorporated also a personal component, including any kind of relation between the person and the object or just between persons (Fernández-Llebrez, 2013). For Herman Hertzberger it had a wider approach, incorporating both thresholds and personal components by linking them to the actions performed by individuals.

*The point is therefore to create intermediary spaces which, although on the administrative level belonging to either private or the public domain, are equally accessible to both sides, that is to say that it is wholly acceptable to both that the other makes use of them*  
(Hertzberger, 2009)

He defined his approach as "in-between space" and it can be understood as a more specific approach to the same concept. Developed in 1959, this concept is mainly illustrated with different Hertzberger's projects of housing for the elderly like De Drie Hoven (1975) and De Overloop (1984). In-between spaces enhance self-expression, supporting individuals attitude for social relations. Hertzberger's approach contributes with an interesting perspective on the person-environment-activity (P-E-A) strategy. Therefore, it has been included as one of the main elements in this research.

At the same time, and as a complement of previous studies centred on activities performed inside the home, like previously mentioned work of

Percival (Percival, 2002), the main interest of this study is focused on outdoor use and transformation through personal objects. The main focus is on the outdoor spaces because identity is associated with our capacity to transform the environment. Our way for appropriating of space reflects our identity. Therefore, there is a special concern about the boundaries between the private and the common space as representative places for customization. At the same time, colonization activities performed by the users through their personal objects were tracked in order to highlight its relation with the space.

# Methodology

This paper shows results of a larger study conducted as a Ph.D. Thesis in the Architecture School of Madrid. The aim of the conducted research was to explore the relation between ageing and the home environment. Thus, examples chosen are part of a larger selection, responding to the author's interest of illustrating identity and colonization outcomes. The study was focused on Denmark, based on the country's importance as a pioneer in developing specific policies on housing for the elderly (Lantarón, 2016). Danish architectural development permitted a deeper study of the different models, as well as an analysis of design criteria evolution among the last 60 years. Methodology follows Johansson's recommendation for architecture and urban planning research based on case studies; *whereas the "case" has to be a complex functioning unit [...] investigated in its natural context with a multitude of methods, and be contemporary* (Johansson, 2003). As well as Yin's definition of Case Study (Yin, 1994).

Strandlund, Wiedergården and Nørre Søpark are representatives of common housing developments for the elderly in Denmark. All of them are located in the Copenhagen metropolitan area, in the so-called Capital Region of Denmark, as suburban and urban sampling. Temporary framework is established after the Second World War and follows Gottschalk's evolution of the different Danish models for housing the elderly (Gottschalk, 1995).

Considering drawing as the main tool used by the architect to represent and understand the architectural design (Cabrero and Martín Blas, 2012), as well as a common practice on architectural research used by many authors like Susan Komossa (Komossa, et al., 2005), different types of drawing have been used for a better analysis of selected cases and as a common code on results' representation.

This method proposes an exportable graphic analysis for tracking colonization by focusing on the relation between personal objects and its placement in the in-between spaces. Drawing representation does not illustrate residents' different ways of using the space, because that would only represent a small and partial range of daily use complexity. It is used as a tool for representing the space and surfaces colonized or potentially colonized by individuals, highlighting the immanent qualities of the basic physical environment that supports personal expression, thus identity. The architectural elements studied in relation with colonization are:

- Different types of access and communication spaces. Characteristics of the architectural layout, dimensions, circulation and static areas, etc...have been explored to understand their relation with users' occupancy.
- Boundaries between public and private. Again, the characteristics of these boundaries have been studied through users' personal objects location and positioning.
- Programmatic relations between interior and exterior. Colonization is understood as an activity linked to personal routines. Interactions between private interior domain and exterior common space have been also addressed to understand users' performance.

Diverse graphic techniques have been tailored to the elements under study, including the use of the most common scales on architecture research and representation. Programmatic diagrams, plans and isometric drawings, in addition to fieldwork pictures, are used to illustrate and compare the environmental characteristics studied.

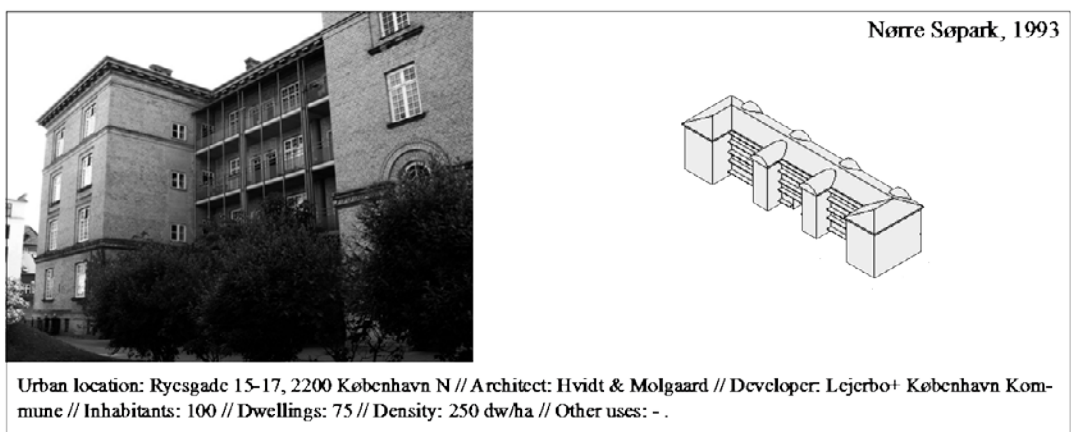
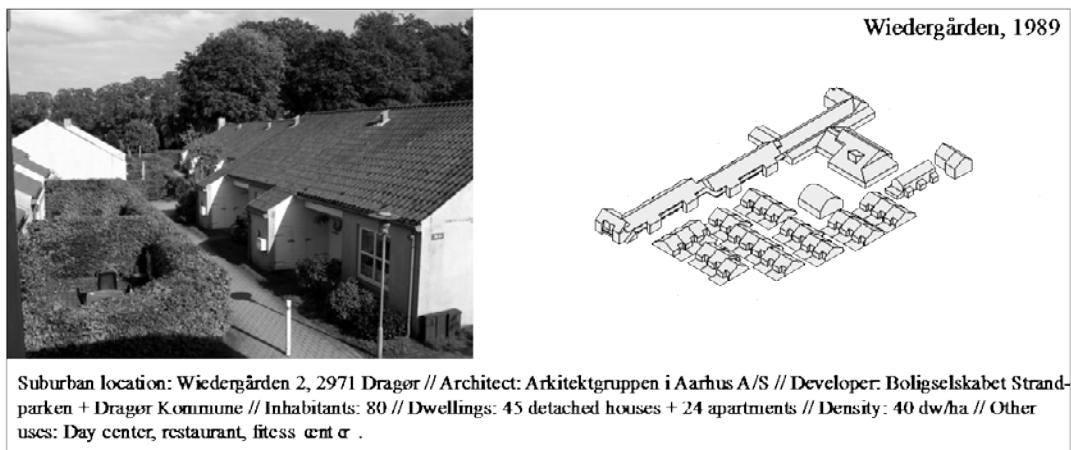
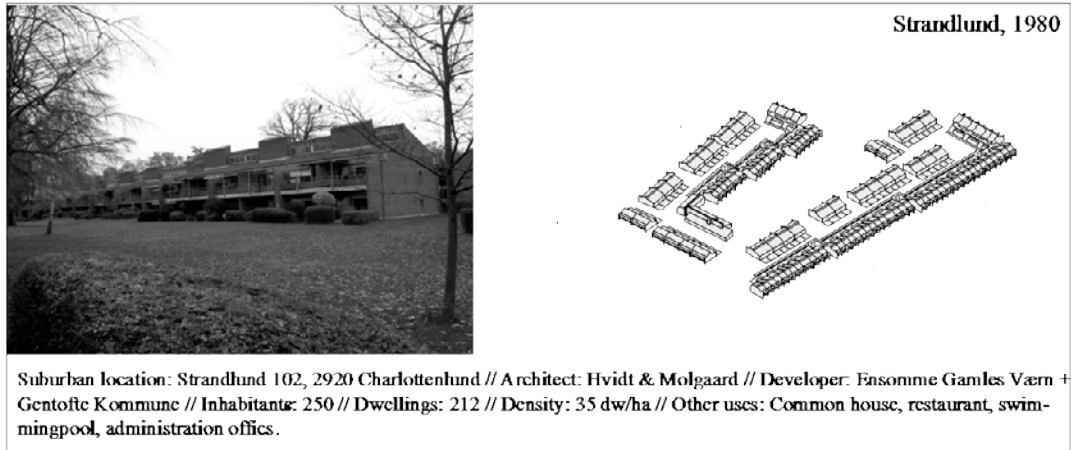


Figure 1. Selected cases: main characteristics.

# Results and discussion

## Access and communication spaces

Accesses can be classified according to the type of connection between private and public domain: directly from the street or through vertical communication cores and galleries. The characteristics and quality of these communication spaces have been analysed in order to find a relation with individuals' performance.

Nørre Søpark was a former hospital which was transformed into housing for the elderly. The main strategy for optimizing the space was to create an outside gallery on every level attached to the existing façade and maintaining existing vertical cores. Therefore, former interior communication galleries were incorporated to new apartments' surface. This strategy created a clear and distinctive constructive language, highlighting the communication element. These new galleries have become a characteristic element beyond the access function. As everyone has to pass by through the gallery in order to access their apartments, this common space reveals as a place for socializing. It is important to highlight that each gallery serves to seven apartments, dividing the whole building in small groups. Its elevated position establishes a more exclusive use, only for inhabitants or visits, meaning common use. A second filter is defined by the apartment group. Only those served by the gallery are normally using that common space, (Figure 2).

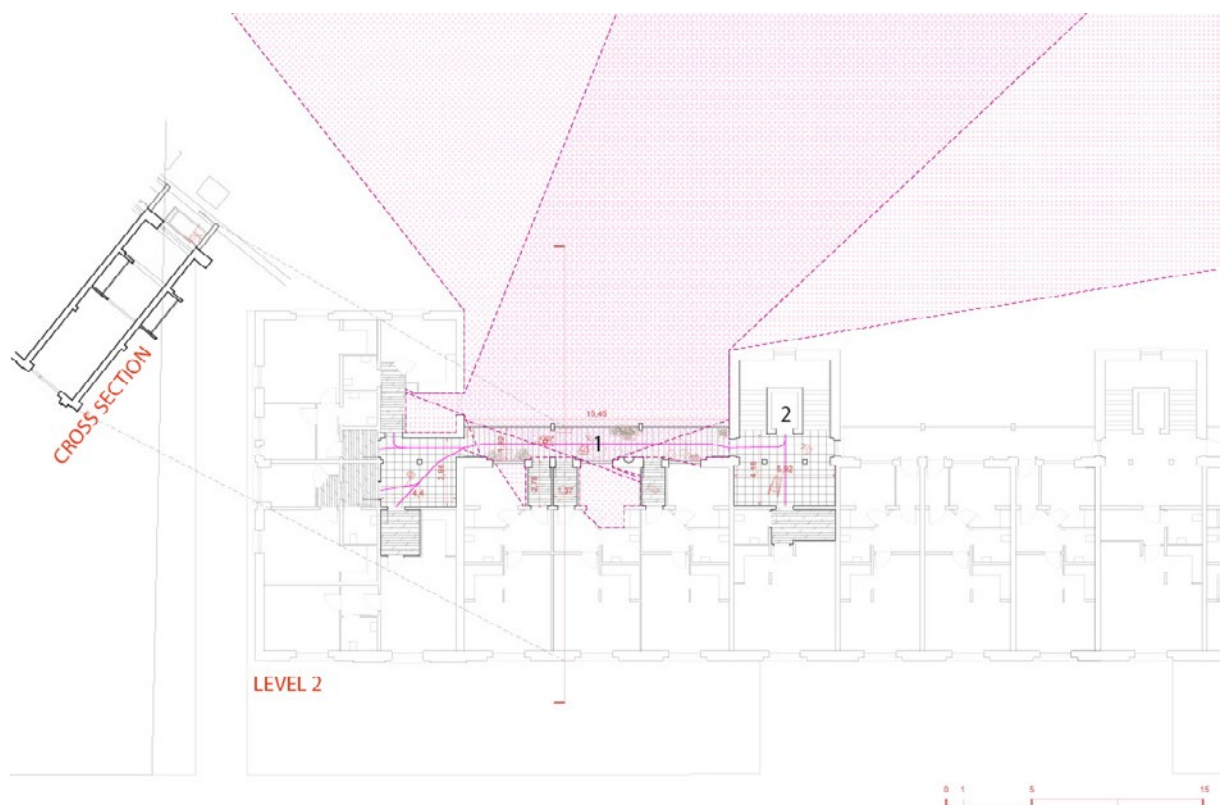


Figure 2. Nørre Søpark. Detailed plan of one of the galleries showing the spatial (grey) and visual relations (pink) between the apartments, the gallery and the rest of the block area.

1. Gallery. 2. Communication core.



Wiedergården illustrates a classical detached houses disposition with direct access from the street. The most interesting quality of this example is how houses define the character of the small streets which, even being part of the public domain, have a strong domestic atmosphere. Every street gives access to one row of houses while the other side is limited by other row houses' backyards. Thus, static private program bounded to the backyards coexist with the public circulation and accesses. There is a bush separating both areas and fencing the walking path. Even this vegetal element is common, individuals can decide its high, allowing some privacy to the backyards. Each street serves from three to seven houses, establishing small groups into the whole architectural ensemble. The dimensions of the path (around 3,00m) allow emergency cars access, but still maintain an individual scale. All the houses have a niche on the main access, as a functional filter, for removing wet clothes, storage objects etc...avoiding a direct access from the outside. These niches act as dynamic filters between public and private domain, containing most of the occupancy actions, (Figure 3).



Figure 3. Wiedergården. Detailed plan of one of the streets showing the spatial (grey) and visual relations (pink) between accesses and backyards.

1. Street. 2. Main access (niche). 3. Backyard. 4. Vertical bush (green fence). 5. Horizontal green use.

Regarding to access, Strandlund has a special character. Architects designed one-storey houses on two levels, with two kind of accesses: from the street in the ground floor and through an open gallery accessed by elevator in the first floor. This strategy generates an interesting spatial relation between the houses. While ground floor has a more public dimension, first floor gallery has a more exclusive use. Gallery wide dimension (1,80m) allows ground-floor houses to occupy covered spaces below it, while at the same time, works as an elevated street for first-floor houses. This means a static character in ground floor, bounded to the houses access, and a more dynamic quality in first floor. Gallery presence is

really strong, due to its long dimension and even architects' effort to break it and divide it, (Figure 4).

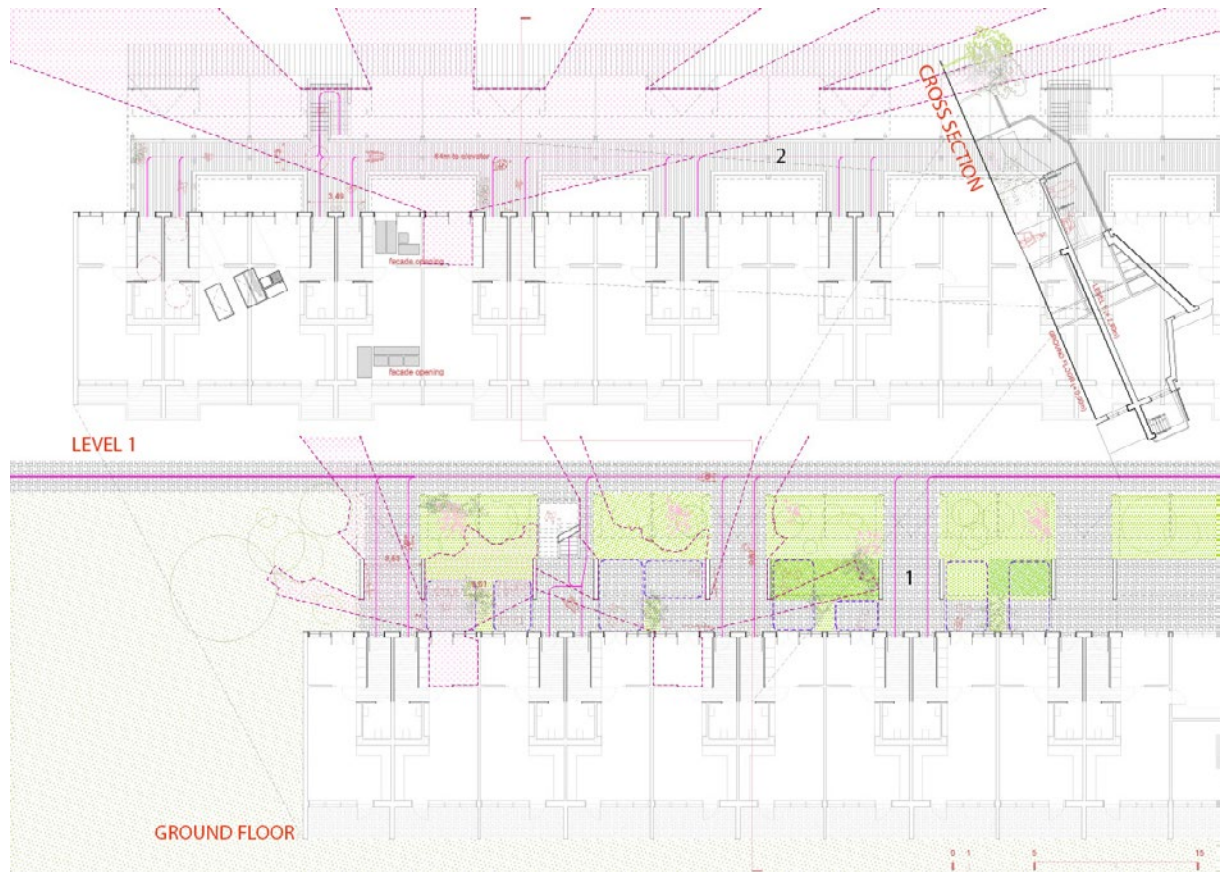


Figure 4. Strandlund. Detailed plan of ground floor (bottom) and first floor (top) showing the spatial (grey) and visual relations (pink) between apartments and gallery. While ground floor has a higher static character, with more limited spaces, first floor works as a communication link open to external views.

1. Access in ground floor covered by elevated gallery. 2. Gallery in first floor.

## Boundaries between public and private

Besides the physical boundaries defined by accesses or communication spaces, there are some interesting limits established by the individuals. Privative use of certain common spaces transform its quality. This kind of use enhances social relations as well as common maintenance. Examples selected illustrate this idea in different ways. In Nørre Søpark, even the limited wide dimension of the galleries (2,00 m), users have colonized the space. Nevertheless, only those with direct access to the external gallery are the ones who occupy it. The level of occupancy is very uniform, probably due to previously mentioned reduced dimensions, and it doesn't affect vertical elements like walls and structural pillars. The most common pattern shows how colonization is limited to siting and staying by placing furniture next to the main door of each apartment. This means in the circulation-free spots. The positioning of personal objects and plants is less predictable, but also limited to the closest surfaces of the apartments door or galleries' handrails. In summary, the appropriation of the space is highly influenced by the dimensions of the gallery; circulation paths and users' performance blur the outlines of public-private, (Figure 5).



Nørre Søpark

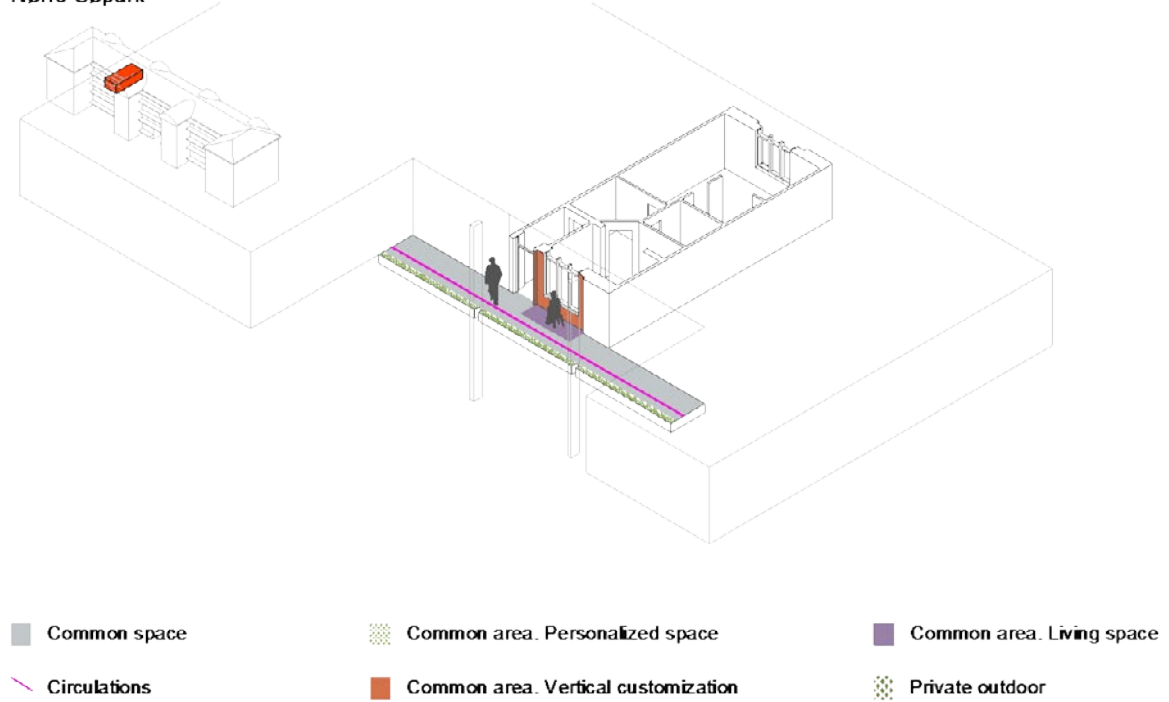


Figure 5. Nørre Søpark. Isometric view of the gallery and its relation with one of the apartments (top), with zoning and dimensions of the architectural elements colonized. Different pictures of users' way of colonizing common space (bottom).

In Wiedergården, as in ground-floor apartments of Strandlund, some green elements create a filter between public circulations and private space. By a privative use of a common space, that is occupying common ground plots in front of windows, individuals decide to such a degree of privacy. At the same time, by selecting the plants, users express what sort of person they are, which are their likes and gardening skills. On free common areas at Strandlund's ground floor, there is also an individual appropriation for different uses, but mainly limited to sitting and staying. Occupancy with exterior furniture follows previous mentioned patterns linked to the main access, (Figures 6 & 7).

## Strandlund

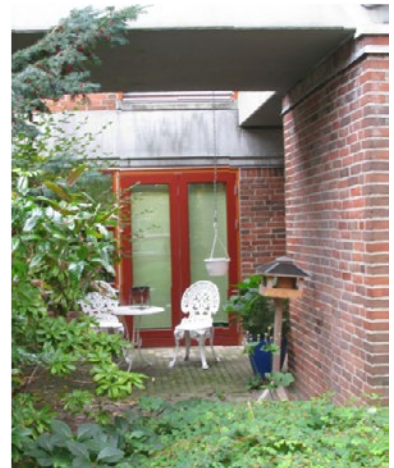
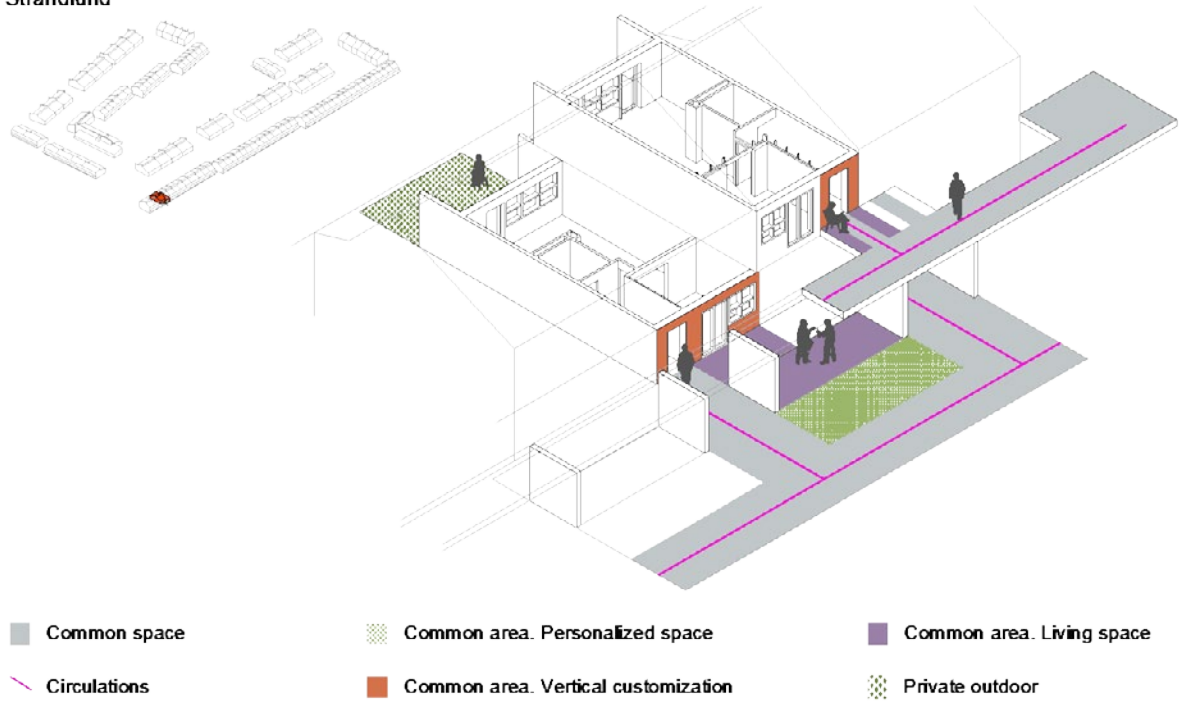


Figure 6. Strandlund. Isometric view of the elevated gallery and ground floor on their relation with the apartments (top), with zoning and dimensions of the architectural elements colonized. Different pictures of users' way of colonizing common space (bottom), ground floor (right and left), first floor (centre).

## Wiedergården

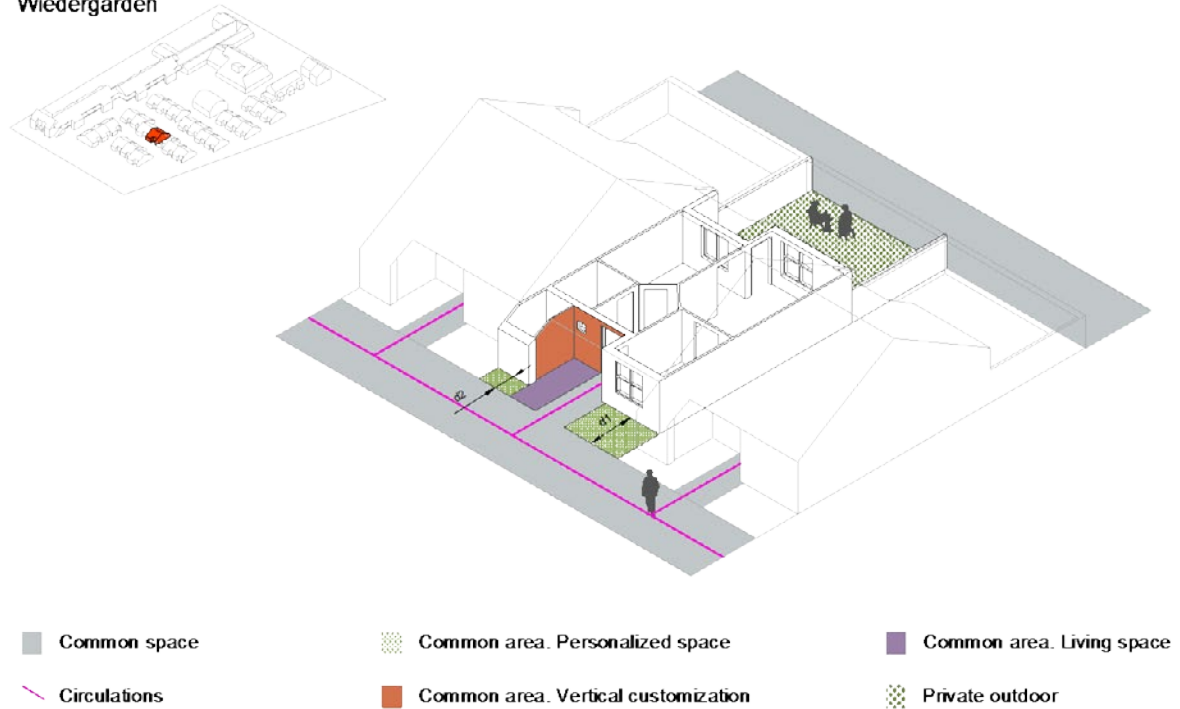


Figure 7. Wiedergården. Isometric view of the street and its relation with one of the apartments (top), with zoning and dimensions of the architectural elements colonized. Different pictures of the street (bottom): niches and users' way of colonizing.

Wiedergården also illustrates a special positioning of decorative objects. Niches are used as delimited spaces to single out individuals' personalities. A clear pattern is bounded to these architectural elements reinforcing the character of the house entrance. Another significant characteristic in relation to self-expression can be found in the elevated gallery of Strandlund. The location of personal objects and plants is limited to the areas in front of the doors, which act as small static spots. No personal appropriation can be found in the adjacent common corridor. Both in Wiedergården and Strandlund, personal expression through objects is clearly delimited and linked to specific areas with specific characteristics. Thus, in these cases, users' performance frames the limits between private and public domain, (Figures 6 & 7).

## Programmatic relations between interior and exterior

The examples selected have a similar functional programmatic distribution. The most public areas of the home are placed next to the entrance, but there is no physical connection with the exterior. Occupancy is very located and physically connected with the interior only through the main door, thus,

colonization is located at the entrance and only visual relations link the kitchen with the common space. In the case of Wiedergården, the most significant characteristic is the fact that the street is defined both by main entrances and backyards. In the same open space coexist a private yard connected to the rooms, facing a niche-entrance connected to the kitchen. Still, visual relations are thoroughly treated to enhance privacy and control. Strandlund's distribution generates completely different dynamics, since some kind of element is needed to maintain rooms' privacy. Vegetal elements, or the fact that the gallery is an obstacle to get closer to the house, keep privacy in the ground floor. On first floor, the design of the gallery acts as a physical boundary by separating from the rooms' façade. On this floor, only the entrances are connected through extensions to the gallery, (Figure 8).

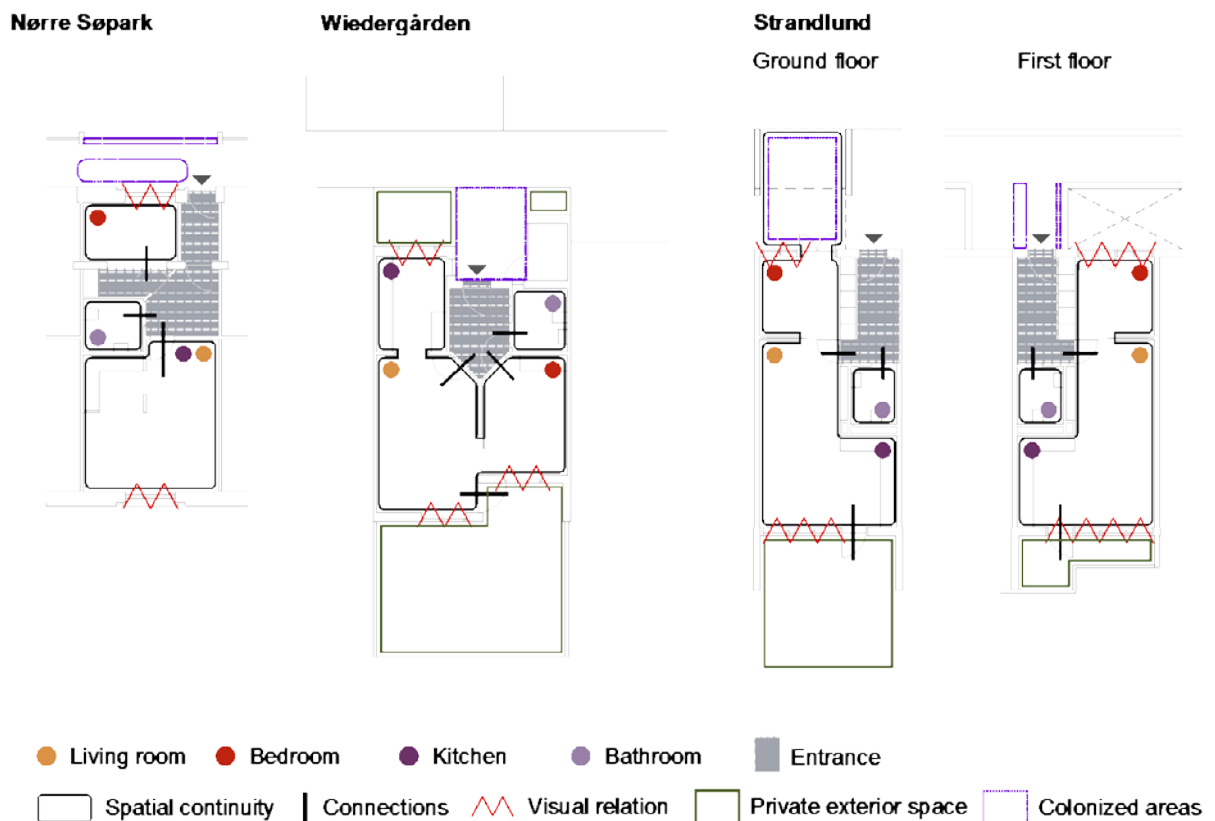


Figure 8. Comparative analysis of programmatic interactions and their link to users' performance.

# Conclusions

Some colonization patterns performed by users can be highlighted in relation to the architectural elements studied:

- Concentration of communications in specific elements reveals as a successful strategy for socialization. However, beyond existing users' objects colonization, better dimensions are required for the enhancement of individuals' performance. Wiedergården illustrates an interesting coexistence between public and private domains. It shows how both can complement each other on the definition of a well-designed domestic atmosphere. Niches show up as effective elements for self-expression, but demand a stronger relation with interior program because the use and activities are strictly located in the private backyards. Strandlund is also strongly characterized by the communication elements. In this case, the gallery works as an important element for colonization and use in ground floor, but has no active use on first floor. Only object colonization can be considered a constant on this proposal.
- Common areas bounded to daily routines, specifically communication elements as well as in-between spaces, are verified as essential components on identity realm. Still, we can highlight two important facts related to individuals' colonization: representative value and activities performed. While the representative value is more associated to symbolic subjects, the activities are linked to programmatic considerations. However, in both cases there is a strong social component behind users' behaviour.
- Activities studied consisted on the colonization with personal objects of vertical and horizontal outdoor surfaces, mainly on thresholds. The characteristics of these objects and their function reflect person identity. In addition, the way to appropriate of space and place those objects is a way for personal expression. A strong symbolic personal role is created by showing individual objects; it represents what sort of person is behind them and how the person wants others to perceive it. By locating certain objects, we establish a symbolic relation, strengthening self-recognition, identification and social interaction.
- In relation with the privative use of public domain, there is a strong link between interior program and adjacent outdoor areas. Personalized use of the common spaces means a better maintenance, reinforcing social interaction. Instead of a generic common space that belongs to nobody, it turns into a specific spot with a semi-private use. The program adjacent to exterior common areas and its physical relation, highly determines the type of privative use. Thus, boundaries between interior and exterior are also essential. A well-designed threshold, with the appropriate associated program, ensures individuals performance and use of the surroundings.

However, even that built environment impact has been deeply addressed on the well-being of persons, the enhancement of identity has been shortly improved since, previously mentioned, Postmodernism revision by Team X. For a long time, healthcare model has focused on a patient-centred approach, developing tailored strategies on services. In comparison, contemporary architectural design on housing the elderly can be illustrated



through twenty-year-old projects. Thus, some design considerations have to be updated.

Individuals' performance and expression within the built environment is a constant value during the life course. Nowadays, boundaries between public and private domain are strongly challenged. New technologies and social individualization can establish more commonalities between people than ever before, but don't necessarily in the same location. At the same time, 30-year-old solutions for the elderly cannot fulfil actual necessities and demands. Identity realm linked to specific environments can be also challenged, so in order to successfully bound the person with the environment, a better level of flexibility is proposed:

- Flexibility in use. Programmatic changes have to be included as part of the life course. Specific solutions targeted to specific social groups force individuals to move regarding their life and social changes. This is especially dramatic for elderly people or persons with specific environmental demands. Universal architectural proposals based on activities performed by the users seem to be more effective than actual trends focused on elderly as a group.
- Flexibility in individuals' self-expression. As colonization of adjacent areas linked to our home can be considered a way of communication, architectural design has to support this kind of expressions. Architectural design can provide a built environment with a high potential for individuals' performance and transformation. With well dimensioned in-between spaces, an appropriate range of materials, as well as the provision of small green areas, the domestic environment can be easily personalized.

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# Insights into living with dementia: Five implications for architectural design

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# Abstract

Due to memory loss, most people with dementia are increasingly disorientated in space, time, and identity, which causes profound feelings of insecurity, anxiety and homelessness. The built environment is expected to hold potential for offering support in coping with the challenges resulting from disorientation. However, scientific research offers little adequate architectural design knowledge.

This paper advances three reasons for this lack of adequate architectural design knowledge: prevailing research takes an objectivist approach to value-bound matters, lacks insights into living with dementia, and hardly addresses architects' core business of form and spatial organization. Next, this article presents and discusses a novel research approach that aims to overcome these limitations, illustrated by a study on how architecture could support people with dementia in orientating in space, time, and identity. This study explored three cases from a critical realist and constructionist perspective and by means of ethnographic techniques combined with an architectural analysis.

Insights into living with dementia are summarized and five implications for architectural design are highlighted: create strategic places, articulate proper boundaries and connections, include everyday places and objects, create contemporary architectural qualities, and take into account social dynamics.

The approach taken allowed to give voice to people with dementia and provide insights into their experiences in a format that helps architects to develop affinity with their perspective. Linking insights into living with dementia with architects' core business, i.e. organization of form and space, is expected to enhance dialogues between architects and their clients, and broaden their view on possible roles of architecture in the daily lives of people with dementia.

*Keywords: architecture, dementia, experience, ethnography, orientation*

# Introduction

When living with dementia, people have to deal with the challenges of progressive memory impairment and loss of other cognitive functions (American Psychiatric Association, 2000; Godderis, Van de Ven, & Wils, 1992; Jonker & Slaets, 2009). People with dementia are increasingly confronted with an unsettling not-knowing of, or confusion about the events and actions that led up to the present situation and about what could follow, being out of touch with people and things in the environment. Such experience of disorientation affects a person at an existential level, yet for people with dementia it is very concrete. It causes profound feelings of insecurity, anxiety, loneliness, and homelessness (Bender & Cheston, 1997; Frank, 2005; Holst, Edberg, & Hallberg, 1999; Zingmark, 2000). In current visions on housing and care for people with dementia, attention goes to supporting them by enhancing their autonomy, individuality, community integration and participation, and by offering them normal, familiar, secure, and homelike living environment (Declercq, 2000; Mens & Wagenaar, 2009).

Gerontologists, social scientists and designers recognize that the physical environment holds potential in contributing to such support (Calkins, Sanford, & Proffitt, 2001; Diaz Moore, 1999; Fleming, Crookes, & Sum, 2008; Van Audenhove et al., 2003). A fair amount of research has been conducted on architectural design for people with dementia (Day, Carreon, & Stump, 2000; Fleming et al., 2008; Mitchell et al., 2003; Price, Hermans, & Grimley, 2000). Yet, scientific evidence is only rarely adopted in architectural practice (Mens & Wagenaar, 2009, pp. 147–148). This may indicate a limited adequateness of available evidence as design knowledge. We discern three possible reasons:

1. Objectivist view on value-bound matters. Common discourses on housing and care for people with dementia address features like personalization, privacy, hominess, scope for ordinary activities and small-scaleness. To scientifically underpin the importance of such features prevailing research starts from a “traditional” worldview, which differs from the rich array of worldviews that may shape environmental design (Diaz Moore & Geboy, 2010). Most studies on design for people with dementia aim to correlate design features with dementia related disturbing behavior and other outcomes (Marquardt, Bueter, & Motzek, 2014) in an objective way, while the importance of the features mentioned above cannot be completely objectified. Indeed, they reflect human values, and more specifically, they reflect an emancipation process of people who want to be valued as individuals and social beings, continue their own life as much as possible, and take part in society (Declercq, 2000; Mens & Wagenaar, 2009; van der Kooij, 1987). Despite this protracted call for humanizing design for people with dementia, prevailing research leaves little room for people with dementia to have their voice heard and taking into account human values. Consequently, it does not provide an explanation for the phenomena studied. This challenge of theory development (like in related Evidence-Based Design research (Diaz Moore, 2011)), may hinder adoption of research findings by architects, who prefer to know why and how architectural features may affect people rather than following design standards (Gray, Gould, & Bickenbach, 2003).

2. Lack of insights into living with dementia. Prevailing studies may not strongly impact architectural design because “they may fail to uncover how and why people use spaces the way they do (Chalfont, 2005, p. 342, italics

original). They do not provide insights into living with dementia. Architects are left with very little information about experiences and daily lives of people with dementia within the environments studied. However, to draw from the potential of architecture in supporting people in their daily lives, such information is indispensable (Crilly, Maier, & Clarkson, 2008).

3. Architects' core business hardly addressed. The third reason why research outcomes are rarely adopted in architectural design practice is that they provide insufficient specification of the physical environment studied (van Hoof, Aarts, Rense, & Schoutens, 2009, p. 147). Moreover, only few studies address form and spatial organization (Marquardt et al., 2014, Table 2), and instead deal with details, so to say, like color, signage, and style of furniture. Such features play a role in architecture and how it is experienced, but they are secondary to architects' core business of organizing space and form (Ching, 1996; Unwin, 2009). The latter concerns features like enclosure, the way spaces are relating to each other and organized into a coherent whole.

In light of these reasons, we took a novel approach, aiming to give voice to people with dementia, offer architects insights into the experiences and daily lives of people with dementia, and bring the findings closer to the field of architectural design. Our study explores how architecture could support people with dementia in orientating in space, time, and identity.

Below, we describe the overall approach and methods used. Next, we summarize the insights into living with dementia and highlight five implications for architectural design. Method specifications and detailed descriptions of the results can be found in (Iris Van Steenwinkel, 2015). Finally, we discuss the potentials and limitations of the approach taken, and make suggestions for further research.

## Approach and methods

On the ontological and epistemological level we respectively took a critical realist and constructionist approach. From this approach, individuals are not affected by the environment in a deterministic way (Davies, 2008, p. 19). Rather, they have particular degrees of freedom in interacting with it and can transform it and develop diverse understandings of it. This approach follows "a growing tradition" - yet hardly adopted in research on architectural design for people with dementia - "of studying interaction in dementia as meaning-based and situated in a context rather than merely as behavior caused by cognitive impairment" (Örülv, 2010, p. 26).

Theoretically, we considered phenomenology a fit perspective for this study, because in phenomenological discourses important themes of the current discourses on housing and care for people with dementia resonate.<sup>1</sup> Phenomenology (especially since Heidegger) questions a mere focus on functionality or rationality, denounces the sterility, uniformity, universality, loneliness, rootlessness, and alienation in modern societies, and it advocates space for intimacy, security, home, familiarity, identity, and relatedness. From this perspective, we considered being oriented as having a sense of oneself situated within a spatial, temporal and social framework (Örülv, 2010); orientating means establishing a mode of relation with the environment (Zingmark, 2000).

<sup>1</sup> However, we do not go along with the extol of place and identity that is often found in interpretations of Heidegger's phenomenology and his critique on modernism (Hill, 2008, p. 115), and that reflects a romanticized, nostalgic view on the architecture of home environments.

Methodologically, we conducted ethnographic case studies. The aim of coming to a rich understanding of people's everyday lives and gaining insights into their experiences is characteristic of ethnographic research, which is generally attributed to anthropology (Davies, 2008; Geertz, 1993). A case study design fosters detail, richness, and in-depth understanding (Flyvbjerg, 2011, p. 301). The first author conducted data collection and analysis, and is henceforth referred to as "the researcher".

## Participants and settings

Three cases were analyzed: two in private housing about Frances (77 years old) and Mary (47), and one in Woodside Residential Care Facility, where we focused on three of its residents, Irene (88), Miriam (74), and Gertrude (87). (All names are pseudonyms.)

### Data collection

Two ethnographic techniques were used: semi-structured interviews and participant observation, depending on the competences of each of the participants. Where possible (i.e., in the case of Mary and Irene) the persons with dementia themselves were interviewed. Data collected include interview audio recordings and their verbatim transcriptions, observation field notes, and pictures.

Although the focus in our study was on people with dementia, their family or professional care givers did not stay totally out of the picture. In the case study about Frances, her husband and main care giver Bob offered a rich account of the design of their house and about their life since Frances had dementia (although the focus stayed on Frances). Mary's husband, on the other hand, is present in her accounts on living with dementia, but he chose not to participate in the interviews. In Woodside, two directors were interviewed about how the architectural design had been established from their vision on care and dwelling and their user-expertise in the lives of the residents. A third director provided a questionnaire about design features that had been filled out by professional care givers during the design process. During participant observation in Woodside, the researcher took notice of care givers' actions, such as their interaction with residents and the way they furnished the dwelling unit.

### Data analyses

In each case study, a textual analysis of the interviews and field notes was complemented with an architectural analysis of the setting.

As is typical for ethnographic research (Davies, 2008; Geertz, 1993) writing took a major part in the study. The researcher created several types of writings, i.e., from field notes, interview transcripts, labels, annotations, and memos to more developed writings and the final written ethnographic account. In line with a constructionist approach, we considered labelling data chunks as a means 'for thinking about if not actually organizing the data' (Davies, 2008, p. 234) that allows a reconfiguration of ideas. Creating labels was a way of searching through, examining, and getting to know the data. NVivo9 (QSR International, 2010) was used to search through data and organize them by means of coding.

Additionally, the architecture of each setting was analyzed. As a guide for this analysis we used ten themes and subthemes defined by Simon Unwin (2009). These 10 themes are: Basic elements of architecture, Modifying elements of architecture, Elements doing more than one thing, Using things that are there, Primitive place types, Architecture as making frames, Temples and cottages, Geometries of Being, Ideal geometry, Themes in spatial

organization. E.g.: the theme 'primitive place types' addresses those types of places that are concerned with important facets of life; 'using things that are there' deals with creating places by embedding buildings within existing conditions and among available environmental elements, such as the shade of a tree, the topography of the site, existing buildings, streets and squares. Because a complete explanation of these themes is beyond the scope of this article we refer to Unwin (2009). We also consulted a book by Francis Ching (Ching, 1996), which provides a catalogue, so to say, of principles of form and spatial organization.

For each case study, the architectural analysis was assembled with the textual analysis of interviews and field notes, which resulted in three ethnographic accounts (I. Van Steenwinkel, Van Audenhove, & Heylighen, 2014; Iris Van Steenwinkel, 2015; Iris Van Steenwinkel, Van Audenhove, & Heylighen, accepted). By complementing a textual analysis of the interviews and field notes with an architectural analysis of each setting, we investigated which dwelling actions – including everyday activities, social interactions, (re)furnishing, and (considerations about) moving to another living environment – were possible within the architectural context, and were performed from expertise-by-experience of living with dementia. In this way insights were gained into the experiences of people with dementia in a format that allows architects to develop affinity with their perspective.

## Ethics

Each case study was approved by the Social and Societal Ethics Committee of the University of Leuven. Participants with dementia (when possible), their caregivers, and facility directors were informed about the study orally and in written form, with the opportunity of asking questions. Afterwards, they were also debriefed about the study results.

## Results

Due to dementia, people have to part with several facets of their daily lives and rely on other people to take over where needed. The dementia process entails attempting to maintain, changing or discarding one's daily life activities, changing social roles and relations with other people – which is likely to entail loss of privacy and control –, changing perspectives on life, priorities and appreciations. In addition, moving to a residential care facility entails the loss of home and related material things, living together with unknown people, and restructuring one's daily life according to the care organization.

The case studies also showed people who wish to remain involved in daily activities in a manageable and comfortable way. They made things easier for themselves (on a physical and cognitive level), undertook alternative activities, and maintained their own routines. In times of distress, they sought comfort either in seclusion or in the proximity of others, or in secure places.

Thus, having dementia highly impacts on peoples' daily life. Their behavior may often seem peculiar. However, our insights into their experiences suggest that their values, desires and expectations, their interaction with people and the built environment are also often not that different from people without dementia, and comprehensible given the circumstances. Consequently, the changes they would like to make to their own living environment may be similar to what other people would like to do in similar settings. Architectural features that enhance the quality of a dwelling to people in general, also count for people with dementia, and might even be more important to them. Both specifications to people with dementia and commonalities are present in the five implications for architectural design, derived from the case studies:

# Create strategic places

For people who become increasingly frail, cognitively and physically, the availability of strategic places is of growing importance. Strategic places allow people to be related to the immediate surroundings in a proper way by occupying a place and by being occupied with an activity in a comfortable, more or less active way. We give two examples.

Mary was not able to do many things and needed to rest often. She spent much time in her armchair in the living room. There, she could take a nap with the chair reclined, look outside, read a magazine or watch television. In order to do so, she had objects ready-to-hand, like tissues, candy, a reading lamp, a magazine, and the TV remote control. Additionally, she had many blankets and pillows. Mary loved to wrap herself in blankets and support her body with pillows. Often one of her little dogs sat on her lap. The rest of the house had to be quiet. In this way she created a comfortable and secure environment to become at ease and recover when she had a bad day.

In Irene's private room, the sitting area offered a strategic place, where she spent most of the day (Figure 1). She could TV, take a nap, or read a magazine. From this armchair, when the door was open, she could call a care giver passing by to help her. On a side table she had the TV remote control, a phone, tissues, a magazine, and a bottle and glass of water. Two chairs were available for when her sons visited.

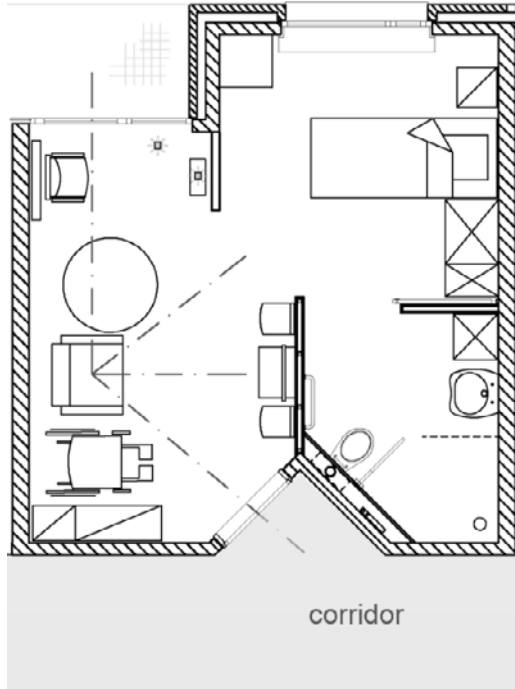


Figure 1: The armchair in Irene's private room offered her a strategic place.

A less fortunate position for Irene was, for example, in a circle with other residents in the living room. She was faced with co-residents, but she did not like them and she could hardly communicate with them. From this position, she could not watch TV or look outside. Her immobility – she sat in a wheelchair, which she could not move herself – prevented her to go elsewhere. Irene withdrew: she closed her eyes and waited until a care giver would bring her to the table for having dinner.

# Articulate proper spatial relations

While strategic places concern spatial relations on the smaller scale, articulating spatial relations is also important on the larger scale, especially in the case of larger and more complex programs of residential care facilities, like Woodside. When many people and activities come together, it is important to define proper boundaries and connections, including boundaries between inside and outside a dwelling unit, transitions between private, communal and public places, and connections with the neighborhood.

Woodside's architectural design consists of a U-shaped configuration to which side wings are attached (Figure 2, a). Its main organizational feature was a U-shaped corridor that figured as a thread throughout the whole building.

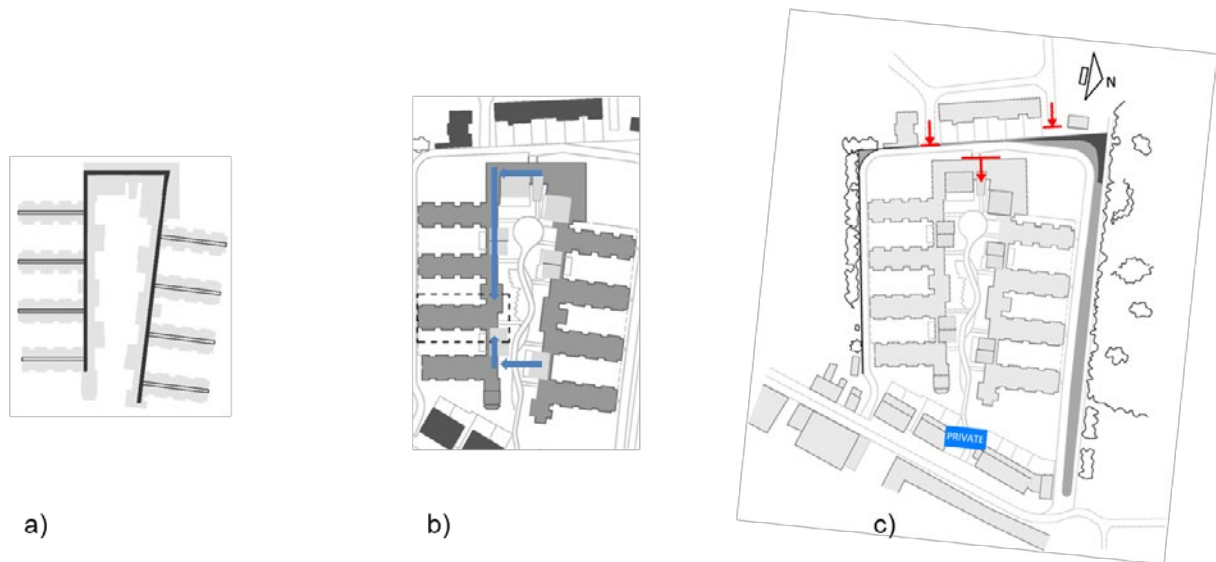


Figure 2: a) Woodside's U-shaped configuration with side wings; b) The corridor offers a rather public passage way through the different dwelling units; c) Woodside's relation to the neighborhood.

This corridor provides a convenient logistic thread, e.g., for care givers on night duty. However, because the corridor ran through all dwelling units, it nullified boundaries between them. In this way, it countered the articulation of each dwelling unit as separate spatial and social unit, and rather formed a rather public, interior passage way along private places (Figure 2, b). On the open side of the U, this configuration allowed to make a connection with the neighborhood. Yet, spatial integration is only limited, because the short segment of the U backs onto a residential area to the west of Woodside, where streets come to a dead end at the border of the site (Figure 2, c).

Because corridors are often used to spatially organize residential care facilities, it is worth considering the several desired and undesired roles they might play in the design at hand.



## Include everyday places and objects

People with dementia often want to and can be involved in daily activities provided that due places and objects are available. This was particularly highlighted in the case study of Frances. Despite the difficulties Frances encountered, she continued to participate in daily activities in a way that was manageable for her. When her husband asked her to go for a bottle of water in the basement, e.g., she also found the clothesline. Then, she had the old tendency to check whether the clothes were dry, to put them into a basket and bring them upstairs. She also helped her husband preparing meals, and she could put some music on. Her husband had bought a CD-player that functioned according to the old logic, e.g., with a turn button for the volume instead of push button on a remote control. Thus, examples of everyday places and objects are a clothesline, a kitchen, a CD-player, also a piano corner for playing music, a garden with a garden shed, and even an outdoor café in the neighborhood for having a drink, enjoy being outdoors and enjoy social life.

The importance of meaningful occupation has already been addressed by other researchers (Vikström, Josephsson, Stigsdotter-Neely, & Nygård, 2008; Zingmark, 2000, p. 24). Considering everyday activities in their architectural context highlights the importance of everyday places and objects. This is something to keep in mind when designing residential care facilities, which often have difficulties with transforming their hospital-like character into the everydayness of home environments.

# Create contemporary architectural qualities

The fourth implication of the case studies for architectural design is to create architectural qualities that are often found in contemporary housing, i.e., light, roominess, relation with outdoors, and an interior with few embellishments.

This implication was highlighted in the case study about Mary. The living room in Mary's house used to be busier, more oppressive to her. When the environment became too busy for her, she could become angry or run out of the house in order to escape from it. In order to counter such oppressive feelings Mary and her husband painted the walls white to make the interior lighter. They also replaced the dark-colored, and highly decorated, antique cupboards with white and simpler cupboards, reduced the number of embellishments, and kept everything well-ordered. In this way, their house became calmer and roomier. There is more room "to breathe" as said in a colloquial sense. When it is nice weather, Mary increased this effect by opening the windows, which gave her more energy, countered oppressive feelings and helped her to become more at ease.

While Mary's behavior of becoming angry or running out of the house may seem peculiar, the changes to their house are not that peculiar. Actually, many other people may make similar changes to this type of house, i.e., a *fermette* (a farm-style house, cf. a cottage in England). Mary appreciated the secure character of her *fermette*, but also its limitations, namely a lack of light, roominess, strong relation to outdoors, and the calmness of an interior with few embellishments. These are architectural qualities that are more often found in contemporary housing. The case study about Mary suggests that people with dementia can benefit from them.

## Take into account social dynamics

The fifth implication for architectural design is to take into account the social dynamics among people living together. As mentioned earlier, social relations and the social environment are likely to change due to dementia. This should be kept in mind when designing architecture.

The case study of Frances, e.g., highlights the importance of places for privacy and togetherness. The house met Frances' changing need for privacy. In the beginning, she preferred to be alone from time to time. She used the bedroom that had belonged to her oldest daughter as a place to retreat. Later, she preferred to have her husband nearby. Of course, he also wanted to continue his daily activities. The articulation of the living room into several 'corners' allowed Frances and her husband to be 'together apart', so to say. There was a piano corner, a sitting corner, a corner with a table and one with a desk. Her husband could work at his desk, while Frances watched television in the sitting corner. In this way, her husband could pursue his own activities (or some of his activities, at least) while his proximity offered Frances a feeling of security.

When many people live together, social dynamics are more complex. In addition, people in wheelchairs need more free circulation space. Also, every seating configuration should provide empty spaces where wheelchair users can take place, which causes the configuration to partly fall apart when the wheelchair users are not there. In addition, flexibility may be needed to accommodate different activities, to change the configuration when more residents come to use a wheelchair, or deal with changes in social dynamics among residents. Aspects such as these create higher challenges to the design of residential care facilities.

# Discussion

This study took a novel approach to studying architectural design for people with dementia. We consider a constructionist approach more fruitful than an objectivist approach. Indeed, the experiences of people with dementia and most architectural aspects that stood out in our study can be comprehended better by viewing them within a socio-cultural context than by formulating them in terms of objective (causal) relations. Our study focused on how daily life meshes with space rather than correlating architectural design features with, e.g., dementia symptoms. In this way, our study responds to the pursuit of people with dementia to continue their own daily lives as much as possible. Moreover, it responds to the potential of architecture, which, in our view, is more likely to consist of providing a proper framework for daily activities and social interaction, rather than countering the dementia process. Therefore, one suggestion for future research on architectural design for people with dementia is to look beyond dementia, and take into account the persons studied as social beings within their cultural context. Broadening the scope in this way also offers the opportunity to draw from and further develop knowledge from beyond the specific field of architectural design for people with dementia, which still largely lacks theory development (Diaz Moore, 2011).

Conducting ethnographic case studies was useful for giving voice to people with dementia, gaining access to the private domain of their home environments, and learning from experts-by-experience. Because in-depth case studies are time consuming, however, the number of cases that could be studied is limited. Ethnographic techniques have been extensively developed within anthropology, but techniques for analyzing architecture as part of scientific research methods are still in their infancy. Exchange between (visual) anthropology and architecture might result in fruitful research methods, and continue the effort of our study to match research findings with architects' approach to designing the built environment.

While it was possible to derive five implications for architectural design, the resulting ethnographies (Iris Van Steenwinkel, 2015) are rather open-ended and descriptive. This may cause some frustration in those who expect the design solution or a set of design standards. However, it may also trigger interest from practicing architects, who are often reluctant towards design standards (Gray et al., 2003). Additionally, through their open and rich character the case studies may inform readers from different backgrounds (Flyvbjerg, 2011, p. 312), like architects and care givers, and facilitate a dialogue between these parties and with people with dementia. Such a dialogue is also facilitated by introducing architectural themes that allow to link experiences of living with dementia with architects' core business. In this way, the case studies can broaden architects' and care givers' insights into the possible roles of architecture in the daily lives of people with dementia.

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# Future design of a children's hospice

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# Abstract

*Children's hospices are a recent concept within the Danish context. Currently, only the small experimental institution "Lukashuset" at "Sankt Lukas Stiftelsen" exists. There has been both an increased demand for and a public and political interest in creating a dedicated children's hospice, similar to those in those in Britain, where the concept is more widespread. In Denmark, the only choice is represented by children's wards, which are ill-suited to palliative treatment.*

*The objective of this paper is to describe and present a children's hospice which has been designed using the integrated design approach to sustainable architecture (Knudstrup, 2004) in an architectural Master's thesis project. The architecture should aid and facilitate palliative treatment for the patients, while relatives and staff also benefit from the healing architecture. The hospice is designed on the foundations of accessibility requirements, the theory of healing (Frandsen et al., 2011) and palliative architecture (REHPA, 2016), as well as experiences from "Lukashuset".*

*The hospice is to be placed in Hammer Bakker, allowing the building to have a calm and natural environment that provides a closer connection to nature. The architecture utilises nature as a palliative element. Sensory stimulation for the patients is achieved through nature, lights, window placement, sensory gardens, and materiality. Functions are placed according to privacy and proximity to one another.*

*A home-like atmosphere and the promotion of wellbeing are key elements in a children's hospice, and since the relatives are deeply affected by the patient's condition, there is a need for the relatives to stay at the hospice while also maintaining work and social life. By creating flexible environments where patients and relatives can control furnishings, light, and climate, the users have personal control over the environment and can create a temporary home. Creating a stable environment for the relatives and patients alike benefits the well-being of all users.*

*In conclusion, the architecture of a children's hospice must facilitate a healing and palliative atmosphere not only for children but also for relatives and staff.*

**Keywords:** palliative and healing architecture, users, well-being, accessibility, sustainable architecture.

# Introduction

This paper is based on a finalised architectural Master's thesis project about the design of a children's hospice. A hospice is a complex building that tries to combine medical treatment, while also offering patients the peace of mind that they require, as if they were at home. A children's hospice is demanding since it involves what we define as the ending phase of life in children, who are technically at the beginning of life. Designing a children's hospice therefore requires the use of a wide field of knowledge. The fields of architecture, engineering and medicine were therefore all used as a basis for the design of this children's hospice. The hospice upholds the requirements for a net ZEB building.

## Background

The concept of children's hospices is not well developed within the Danish context. "Lukashuset" in Copenhagen, currently the only children's hospice in Denmark, opened on 1<sup>st</sup> November 2015 with only four rooms and the goal of reaching 75% occupation; it is constantly at full capacity. The hospice offers guidance and relief stays for children with severe chronic illnesses, in addition to terminal children, meaning that the hospice is not exclusively for the terminally ill (Poulsen et al., 2016) (Hørlück, 2016) ("Børnehospice - Sankt Lukas Stiftelsen", 2016).

There is a real need for children's hospices in Denmark. While children with cancer are treated well within the Danish hospital system, many children born with rare neurological diseases lack specialised palliative care. (Poulsen, Hoff, & Lund, 2016)

In Britain there is a longer tradition of building and maintaining children's hospices. A well-established foundation for the palliative care of children, "together for short lives," exists as a framework for children's hospices and similar institutions across the British Isles. ("Children's Charities - Children Hospices - Together for Short Lives", 2016)

Relatives of ill children will use all their resources in caring for and helping their child. Often the parents' work lives, social lives and siblings suffer as a result. If a child can enter the care of a children's hospice, relatives can be relieved of some stress and emotional trauma. The patient units at the hospice aim to provide a safe and homey atmosphere far from the sterile environment of a hospital. The environment is flexible enough to encompass different personalities and cultures (Poulsen et al., 2016) (Hørlück, 2016).

# Method

The building must be designed using a holistic approach to architecture. Therefore, an integrated design approach to sustainable architecture is used. (Knudstrup, 2010)

The project bases itself on an analysis of the field of knowledge that is connected to the problems encountered when designing a children's hospice. The concepts of healing and palliative architecture were therefore vital frameworks to draw upon while designing the hospice.

An interview with development worker Signe Hørlück from "Lukashuset" provided much-needed experiential knowledge from the only children's hospice in Denmark. In particular, the information about the different groups of users and the functionality of a children's hospice were useful.

When working with a building type where users will have a wide range of abilities, it is important to consider not only accessibility but also universal design. This takes into account not only the kinetically disabled but also the sensory impaired. Compared to adults, small children as per their nature have lower levels of physical capacity, and therefore universal design measures should be used (Ryhl, 2009).

## Integrated Design

The intention of this project was to design a building with a low energy demand through an integrated design approach (Knudstrup, 2004). Integrated design in architecture is an iterative process, using knowledge from architecture together with engineering and, in this case, research-based knowledge from palliative and healing architecture (see below) in order to inform the design with knowledge through the design process. The method moves through several phases, from a phase where the problem is formulated through analysis and ending with formulated design parameters around sketching, synthesis, and finally the presentation of the project. This is done through an iterative design process, whereby each phase can be reiterated with knowledge gained from a later stage. This allows the project to be based on knowledge feedback and for structural, energy, or climatic calculations to be active tools in the sketching and design process (Knudstrup, 2004 and 2010).

## Healing and Palliative Architecture

Healing architecture is the evidential concept that architecture can influence the healing process in patients through alterations of the architectural parameters that affect the healing process. The parameters are placed into three groups: body, relations, and safety (Frandsen et al., 2011).

All parameters have different influences. For example, those of the body relate to the senses, and therefore relate directly to the wellbeing of the patient. These are factors such as sound, light, and aesthetics. The body parameters have been used extensively in the project as a tool in architectural solutions. Relations are human interactions and the way in which they are facilitated, along with many of the functions in the hospice, are shaped with

regard to the levels of human interaction. Safety is all encompassing in the building and many technical considerations have been made to increase safety (Frandsen et al., 2011) (Poulsen et al., 2016).

Palliative architecture is a subset of healing architecture that changes the focus from healing the patient to palliative treatment. The wellbeing of relatives plays a larger role in palliative architecture than it does in healing architecture. Many of the parameters in healing architecture are repeated in palliative architecture, but the weighting of the parameters is different. Palliative architecture does not take into consideration the length of the stay or the healing periods. Rather, it focuses on how to minimise the chronic symptoms and create a dignified existence for the afflicted ("Arkitektur & Lindring - Rhepa", 2016).

# User Groups



Figure 1. Entrance to the building at the day centre with a view of the courtyard (Poulsen, Hoff, & Lund, 2016).

There are three major user groups in the hospice: the patients, the relatives, and the staff (Figure 1) (Hørlück, 2016).

## The Patients:

The patients are chronically or terminally ill and, in most cases, suffer from severely reduced mobility. They will be bedridden for longer periods of time and will be under the intensive care of staff. They are underage, meaning that their self-determination is very low and they have little to no control of their situation (Olds, 2001) (Hørlück, 2016).

The patients range from 0 to 18 years of age, which means that among themselves they are physiologically and psychologically very different. The gap from infant to teenager is vast, and therefore the hospice should cater to the varying requirements of the patients, mainly through flexibility. Age specific activities should be established and organised in such a way that they don't interfere with one another. Age differences mean that patients will depend on their relatives (Poulsen et al., 2016) (Hørlück, 2016).

## The Relatives:

The relatives are put in a vulnerable position when their child is terminally ill and suffering. Since many of the patients are children, they are dependent on their relatives. Therefore, the relatives should be able to stay at the hospice permanently. Relatives need to feel that the patient is in safe hands and cared for attentively. The more comfortable the relatives are, the more they will actively contribute and involve themselves in the patient's treatment,

which in turn also makes the staff's work easier (Poulsen et al., 2016) (Hørlück, 2016).

## The Staff:

For the staff, the building is a workspace which must serve their needs during the workday.

To provide the necessary functions to enhance the workflow of the building, the different groups of staff should be identified.

The most pervasive group comprises the caretakers; they are the nurses taking care of the patients on a 24-hour basis. There would ideally be one nurse for each patient during the workday, and one for every second patient during the night.

The group of therapists and doctors present during the working hours are called the palliative team. They consist of occupational therapists, physiotherapists, and a paediatrician. They will generally require adequate facilities and consultation rooms to perform their duties.

Volunteers are a vital part of the workflow within the hospice, often taking care of smaller tasks that the professional staff cannot find the time to do.

Management are the administrative staff that primarily performs office-based work. Management personnel are divided between the daily hospice leader, a development leader, and a chief nurse. The managerial staff require separate offices.

The hospice should support the staff in their duties when conducting patient care and allow them to withdraw from the patients to do administrative work. It is important that the professional functions don't impede the home-like atmosphere of the hospice (Poulsen et al., 2016) (Hørlück, 2016).

# Presentation of the results from the design of the children's hospice

Flow and function.



Figure 2. Approach to the hospice through the woods (Poulsen, Hoff, & Lund, 2016).

Approaching the hospice takes place through the forest of Hammer Bakker. A road leads directly to a drop-off point in front of the hospice, thereby minimising the walking distance. The drop-off point is placed under an extended canopy, leading to the hospice entrance (Figure 2) (Poulsen et al., 2016).

The functions of the building are placed on either side of the central hallway. Open functions flow into the hallway, an inviting gesture that opens up the functions into the public spaces (Poulsen et al., 2016).

The hospice should be easy to navigate, comprehend, and traverse. Universal design is an essential tool when constructing a building like a children's hospice, and the building should be accessible to all individuals. Within palliative architecture, navigation should be simple and buildings should not be confusing, using a sensible navigational pattern with little to no need for signage or directions ("Arkitektur & Lindring - Rhepa", 2016) (Frandsen et al., 2011) (Ryhl, 2009) (O'Neill, 1991a) (Werner & Schindler, 2004).

In the field of healing architecture, there have been studies comparing rectangular plans and circular plans and the patients felt more sheltered by the natural blockades provided by the circular plan (Frandsen et al., 2011) (Van Dijk, P., 1995).

The plan used in the project is an ellipsoid, which is easy to navigate and allows for a reasonable distribution of functions based on their proximity and levels of privacy (Figure 3). At the entrance is the day centre for ambulant patients, together with a canteen and consultation room. At either side are the staff functions and treatment facilities, which require a higher level of privacy. Located the furthest away from the entrance are the patient units as



well as the common room and facilities for the permanent residents. All of these areas require a high level of privacy and should remain relatively undisturbed by hospice visitors. The middle of the ellipsoid consists of an interior courtyard garden (Poulsen et al., 2016).

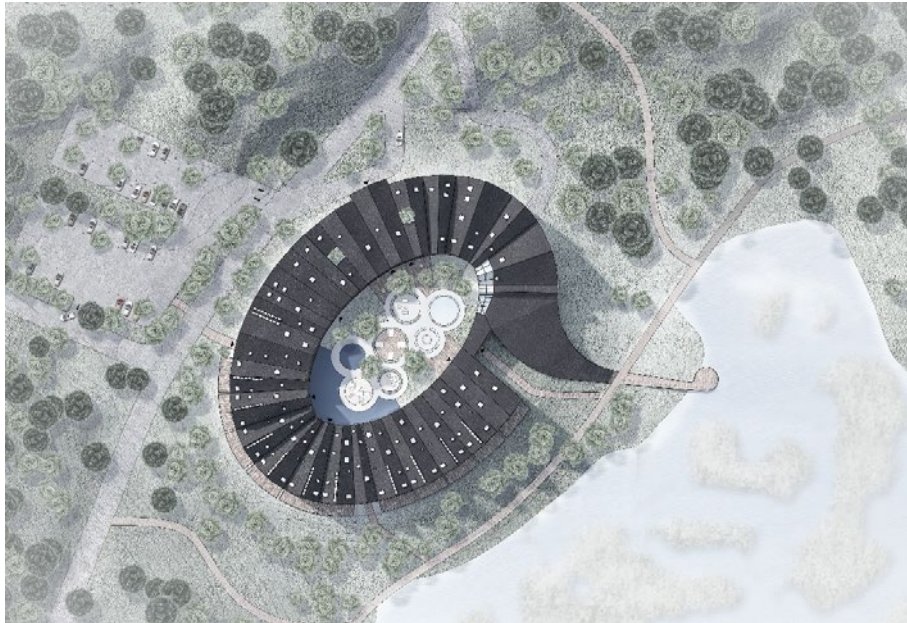


Figure 3. Situation plan (Poulsen, Hoff, & Lund, 2016).

To ensure full accessibility, universal design has been utilised. Universal design is a method for accommodating all persons regardless of age or ability. In this design, universality has been attempted by having the building be completely planar; all spaces are dimensioned for accessibility, even if the patient is bedridden. The plan layout is simplified to a degree, whereby it is assumed that everyone would be able to navigate it without effort (Poulsen et al., 2016) (Ryhl, 2009).

The roof structure is composed of a series of interconnected gable roofs inspired by a traditional cabin in the forest. Each roof defines a function in the outer ring, which gives the building a sense of scale. The roof lowers in elevation and slopes toward the green interior courtyard, which lowers the scale in tune with the narrowing of the roof due to the ellipsoid shape. This also leads rainwater into collection tanks that are placed below the courtyard, and the water is in turn filtered and used together with grey water for flushing the toilets. The roofs also contain solar panels, and the roof elevations and orientation have been parametrically optimised for solar radiation. Therefore, the need for electrical power is surpassed by the solar power production of the building (Poulsen et al., 2016).

Geometrically, cold bridges are minimised, creating a building with lower heating demands since it is able to hold on to waste heat effectively. The building is highly insulated and a heat pump is used. (Poulsen et al., 2016).

## Private and Social Spaces

The nature of terminal or chronic disease makes everyday life unpredictable and infers a lack of control for patients and relatives. It is vital to offer private spaces for the relatives and the patients, where they can be in control of their environment (Frandsen et al., 2011) ("Arkitektur & Lindring - Rhepa", 2016) (Hignett & Evans, 2006) (Reed, R. A., 1995). Relatives need the ability to withdraw and be alone with their thoughts, or be together as a family in privacy (Frandsen et al., 2011) (Chaudhury, Mahmood, & Valente, 2004).

Families that stay permanently at the hospice are given patient units that house both the patients and their relatives (Figure 4). The patient units in the project are designed to house relatives and patients in separate rooms with a shared bathroom. The rooms are separated by a sliding door and when opened the rooms are joined together; both rooms have access to a private terrace. Each of the rooms and the bathroom connect to the hallway, allowing the relatives to carry on with their daily lives without disturbing their child and allowing family members to sleep through the night without being disturbed by nightly treatments of the patient (Poulsen et al., 2016) (Hørlück, 2016).

Considering the permanent patient's situation, whereby the hospice acts as their final home, the units should be flexible in allowing the patients and families to furnish and decorate the units to their liking. The patients and relatives thus gain control over their environment. A homey atmosphere is necessary in palliative treatment. The children and their families have undergone stressful hospital treatments and diagnostics before arriving at the hospice, another reason to avoid an institutional atmosphere not only in the units but also in the hospice at large. Child behaviour changes when they are in a home-like atmosphere, they feel safer and play more complex games. Therefore, the plans in the patient units are relatively open and the only constraint is the ceiling lift from the patient's bed to the bathroom. The lift is integrated into the ceiling to minimise visual intrusion. While a mobile lift may provide similar benefits, studies show that ceiling lifts are more convenient for staff and will therefore be used more frequently, significantly lowering injuries related to lifting patients. In the ceiling, there will be LED light insets that can be controlled by the patients; these act as a "starry sky" with changing colours and compositions. The point of the LED lights is to act as a tool for palliative treatment, while also giving the patient a larger degree of control over their environment (Frandsen et al., 2011) (Olds, 2001) (Poulsen et al., 2016) (Hørlück, 2016) (Reed, R. A., 1995).

The indoor environment in the patient units, like all other elements in the unit, must be flexible. The patient will stay bedridden for most of the time and they will need a higher base temperature. Indoor environmental simulations are calculated with a temperature goal of 23 degrees Celsius, compared to the average of 21 degrees. Since the patients have different needs, they may also have different climatic requirements. Therefore, the indoor environmental simulations aim for a robust strategy that would be capable of handling different environmental loads. To reach these requirements, the room is ventilated by InVentiale systems with VAV-control that can be manipulated by the patient through an application on a tablet or smartphone. A central controller should be easy to use for children and generally adhere to universal design. Floor heating is established in the unit; this is an efficient method of distributing heat and invites children to play on the floor (Olds, 2001) (Frandsen et al., 2011) ("Inventilate," 2016) (Shumaker & Reizenstein, 1982).



Figure 4. Patient's room of the patient unit; LED lights in the ceiling; door to the right connects to the relatives' room (Poulsen, Hoff, & Lund, 2016).

Relatives need space for sensitive conversations among themselves and the staff. This is provided by conversation rooms; these rooms are quiet spaces with doors that can only open from the inside, allowing complete privacy. (Poulsen et al., 2016) (Hørlück, 2016) (Astedt-Kurki, P. et al, 2001).

The ability to socialise is another consideration. Children, whether patients or relatives, thrive from socialising to a degree that they themselves can control. Teenagers may be more withdrawn but still require access to a social sphere of likeminded individuals. When considering the social rooms, it is therefore important to factor in age and ensure that the needs of both children and young adults are taken care of ("Arkitektur & Lindring - Rhepa," 2016) (Realdania, 2009).

The social areas are planned to be flexible, partitioned, acoustically pleasant, and contain functions that strengthen social activities. Social interactions should be encouraged not just within the individual families but also between the families. Kitchens only exist within common rooms to ensure the individual families are obliged to venture outside the patient unit, thereby having to interact with other families and patients at the hospice (Poulsen et al., 2016) (Hørlück, 2016) (Holm, 2003).

A small pool is planned in the north-eastern section with a view of the surrounding nature; this serves as a palliative treatment facility. While a tub would have a similar function, the basin allows for families to participate in the treatment. The involvement of family, and especially siblings, who are often left out as observers, helps create memories and softens the trauma of a dying child or sibling. (Poulsen et al., 2016) ("Arkitektur & Lindring - Rhepa", 2016) (Healy, V., 1986).

## Workflow and Personnel

Staff routines are also a consideration in the design process, with the staff wing of the hospice placed near the entrance. This area consists of administrative functions like offices and meeting rooms (Poulsen et al., 2016).

The staff can use this area for registrations without being disturbed by patients or relatives. Placing it close to the entrance allows guests to visit without disturbing permanent residents (Poulsen et al., 2016).

Staff on duty will generally be in the watch room close to the patient units, where they can quickly respond to situations. The medicine room is placed near the watch with access to daylight to minimise errors (Poulsen et al., 2016) (Frandsen et al., 2011) (Chaudhury & Mahmood, 2007) (Buchanan, Barker, Gibson, Jiang, & Pearson, 1991).

## Utilising Nature



Figure 5. View of the hospice from Pebermosen (Poulsen, Hoff, & Lund, 2016).

Access to and views of nature are essential in healing architecture. Views and access to nature reduce stress for all parties involved in the treatment process (Frandsen et al., 2011) (Ulrich, 1981) (Hartig et al., 1995).

Allowing patients to have access to scenes of nature lowers stress while also heightens their pain thresholds. The effect of stress reduction effect is likewise beneficial for relatives and staff ("Arkitektur & Lindring - Rhepa", 2016) (Ulrich, 1984).

Based on these studies, the hospice should be placed in an area that offers a calm natural beauty. Hammer Bakker, situated in the suburbs of Aalborg, has historically been used for precisely this reason and therefore the site at Pebermosen was chosen (Figure 5). Hammer Bakker is also near a highway access, point which connects it to the future site of the Aalborg University Hospital (Poulsen et al., 2016).

Creating access to natural scenes requires that rooms be orientated so that the functions that benefit from these views are prioritised. Due to the shape of the building, these functions should be placed in the outer ring (Poulsen et al., 2016).

In the day centre, two interior gardens flank the entrance, blending nature into the building while also signifying a change in functions through the building from the very public day centre and the canteen to the treatment and consultation area on one side and the staff area on the other (Poulsen et al., 2016).



Patient units and the common room for permanent patients are prioritised with views towards the lake and the fir forest. Functions of a private nature have been orientated away from access roads and toward the elevated parts of the site (Poulsen et al., 2016).

The view to the outside has to be balanced with the need for privacy and concerns about the indoor environment, especially overheating. Since the site is actively used by the public, it is important to consider the window compositions in the façade (Poulsen et al., 2016).

A thorough investigation would consider different façade solutions, taking into account daylight, overheating, views from the exterior and interior, the height of children and the effects on the building's envelope (Poulsen et al., 2016).

Simulations measuring the daylight and solar radiation factors were performed to determine the feasibility of different solutions. The major differentiations were a full glass façade, smaller scattered windows, and smaller windows combined with skylights. Scattered smaller windows and two standard-sized windows per function combined with skylights would be the optimal solution, and the standard-sized windows (one square and one vertical/rectangular) would repeat along the entire building façade to create rhythm in the smaller scattered windows. The daylight factor would be high on average over the entire room, but compared to large glass facades would be private, blocking views from the exterior. Outdoor shades regulate insolation (Poulsen et al., 2016) (Hørlück, 2016).

The composition of the windows has the effect of framing the exterior in shifting glimpses as the users move around the interior space. This corresponds with the children's need to sense, experience, and observe subtle changes in the world surrounding them. In the patient room, one skylight is placed directly above the patient's bed, allowing the bedridden patients to observe the sky, while the other skylight is angled to view into the sky when the patient is sitting and also illuminates the wall opposite the patient. The room is bright but the light and shadow change throughout the days and the seasons, creating a sensuous dynamic light affecting the circadian rhythms and moods of the patient (Olds, 2001) ("Arkitektur & Lindring - Rhepa", 2016) (Frandsen et al., 2011) (Wallace-Guy et al., 2002).

Throughout the interior hallway, views into the landscape and the courtyard create a sense of place and direction. Larger glass facades are used since the spaces are of a public character and contain niches for those still wanting privacy. Using large windows in spots creates sudden vistas, revealing the surrounding landscape for users and visitors (Frandsen et al., 2011) (Ulrich, 1981) (Hartig et al., 1995).

To ensure access into the surroundings for even the weakest patients, the surrounding paths should be curved to an appropriate elevation and covered with easily navigable materials (Poulsen et al., 2016).

## Outdoor Spaces

Access to outdoor spaces benefits all users differently but is unanimously positive. (Frandsen et al., 2011).

Children mainly (siblings but also sick children) can take an active approach to the outdoors by playing and exploring, while adults can use the area for breaks, relaxation, and reflection. Often, the outdoor spaces are used for activities like talking or eating. Outdoor spaces are also used more frequently if they are connected with interior functions, like common rooms or cafeterias,

and are easily observable and accessible (Olds, 2001) (Frandsen et al., 2011) (Marcus & Barnes, 1995).

In healing architecture, studies have shown that families with terminally ill children additionally showed a desire for niches in the outdoor spaces where they can have privacy (Frandsen et al., 2011) (Whitehouse et al., 2001).

The outdoor space in the project is an interior courtyard divided into different areas aimed towards patients, relatives, and staff. The areas connect to the building volume, extending and complementing the interior functions. The courtyard serves as a sheltered sense garden as well as a safer controlled alternative to the surrounding forest ("Arkitektur & Lindring - Rhepa," 2016).

All outdoor spaces are level with the interior for accessibility, creating seamless transitions from the interior to the exterior (Poulsen et al., 2016).

All vegetation in the courtyard consists either of plants that are colourful and emit stimulating fragrances or of larger trees. This offers the patients sensory impressions, which are important for palliative treatment. Trees create shade, which helps to prevent the overheating of the interior during the summer months while allowing sunlight to enter in the wintertime. In particular, the functional spaces placed to the north of the courtyard benefit from the shade. Bushes and tall flower beds create small private spaces that are separated from the rest of the courtyard. This sectioning also stimulates the explorative nature of children who are interacting with the environment (Olds, 2001) ("Arkitektur & Lindring - Rhepa," 2016) (Whitehouse et al., 2001).

The interior playroom extends out into a playground covered in blue rubber, which allows for children's play to take place on the ground while also protecting children from harm in the case of falling (Olds, 2001).

Outside, terraces for the common room and day centre areas are planned; these allow for the interior functions to flow out into the courtyard. Food prepared in the common room kitchen or canteen can be eaten here. In turn, the exterior sensory impressions from the courtyard flow indoors (Frandsen et al., 2011) (Marcus & Barnes, 1995).

A circular pond is placed in front of the orangery and the pond invites children to play as well as offering further sensory impressions, granting a calming aural ambience for the courtyard (Olds, 2001) (Whitehouse et al., 2001).

# Discussion

Children's hospices are a new concept in the Danish context. While the success of the only children's hospice in Denmark, "Lukashuset" demonstrates the potential for a full hospice, it is still worth considering why one should be built in the first place.

Currently, the only real choice for families with chronically or terminally ill children is to stay in children's wards at hospitals. The function of the hospital is curative treatment with the goal of sending the patient home as quickly as possible. Therefore, hospitals are designed for this transient condition, whereby each architectural parameter is weighed against the health of the patient and the ability to keep the environment sterile.

While there seems to be a shift towards smaller patient quarters and single rooms in newer hospital buildings, the children's wards are largely composed of rooms with 10 to 25 beds. Contemporarily, there is also a large priority given to cancer treatment in hospitals, meaning that children with rarer congenital conditions have a lower priority (Poulsen et al., 2016) (Hørlück, 2016).

The experiences from "Lukashuset" indicate that cancer patients are generally well cared for at the hospitals and that the patients who seek the children's hospice are those with rare terminal or chronic diseases (Poulsen et al., 2016) (Hørlück, 2016).

The hospice, while maintaining many similar functions, should stand in contrast to the transient atmosphere of a hospital. The justification for the hospice is in the fact that while it may not cure its patients, it can give them a dignified existence. In ordinary hospices, death is a natural occurrence whereby the relatives will have to accept the mortality of their relatives. A children's hospice deals with relatives who are more vulnerable, since losing a child is a traumatic experience that can shatter the life of the parent. In the children's hospice, the relatives are just as much a focal point as the patients. Since the relatives will have to carry on with their lives, the hospice should give them the tools for learning how to do so while also relieving them of the burden that a chronic and terminally ill child undeniably places on a family's social and emotional life. Experiences from "Lukashuset" show that the hospice can work as a place of relief for these families, letting chronic but not terminal patients stay for a short duration, whereby shifting the palliative treatment between permanent residence and guidance at home can make the families more balanced (Poulsen et al., 2016).

Therefore, the hospice is as much a place to help relieve relatives of a traumatic experience as it is to relieve the patients of their symptoms.

# Conclusion

## User Groups:

Designing a children's hospice requires taking into consideration a multitude of goals that must be achieved. The integrated design process is therefore an ideal choice because it makes it possible to design using a multitude of interconnected and strategically chosen parameters. The hospice contains three very different user groups, who have distinct needs and extremely different reasons for being in the hospice, making fluent transitions between home-like atmospheres and a professional work environment essential.

For the personnel, the hospice is a workplace and thus for them the architecture should facilitate their workflow and load. Creating a planar building and designing accessible facilities results in a building where lifts are only necessary in a few places and they can be integrated into the building. This in turn means relatives can transport patients themselves, which removes a significant amount of the strenuous work for the staff.

For the patient, focus must be placed on creating homey atmospheres, using material, light, and flexibility. Access to and scenes of nature likewise have a proven effect on palliation, while sensory gardens can refine and control the environment, allowing access to nature for even the most ill-disposed. The patient needs a stable environment where they can achieve a degree of self-control. While these parameters should be fulfilled, the environment should still inspire life rather than lull the patient into a terminal stasis, and thus playrooms nearby and views into areas that are actively used should not be avoided, as long as the option to shut out these impressions is also available. Relatives must feel safe and that the patients are taken care of. In the case of small children, relatives will most likely be parents or other close adults.

As a result, it is important that the hospice can facilitate their presence through extra rooms. All rooms within the patient units should connect into the hallways, allowing free access into the units without disturbing either the patient or the relatives. Some behavioural conditioning should be considered in the architecture, like removing kitchens from the patient units to prevent relatives holing themselves up and isolating themselves mentally

## Healing Architecture:

A main driver of design for the hospice was the framework of the elements of healing architecture.

*Body:* The sensory elements are used in the phenomenological approach. Daylight, access to nature, indoor climate, and space are considered in such a way that the design complies with studies presented within the field of healing architecture. Daylight penetrates the entire building and the same openings that allow daylight to enter are placed so as to create vistas into the natural surroundings. The sensory experience in the building matches with the functions; the patient rooms are quiet, with plenty of daylight and views to nature. The common room, on the contrary, can open into the surroundings, letting sounds of life from the courtyard and playrooms propagate, while niches still provide privacy (Frandsen et al., 2011).



*Relationships:* The hospice has several rooms and facilities that serve as a driver for social interactions, either as a primary or secondary function. Social functions like cooking and dining are moved from the patient units to communal areas in order to frame social interactions between occupants and across families. The patient units frame intimate family life. They protect from external disturbances and the two rooms of the patient unit can combine into a single-family room (Frandsen et al., 2011).

*Safety:* Implementations for ensuring safety mainly connect to the personnel. Integration of lifts into the ceilings and pairing these with the functionality in the rooms should minimise work-related injuries by lifts. Similarly, the planar circular layout is there to ease the transportation of patients. In the detailing, making all touchable surfaces, such as door handles, made of copper or brass lowers the risk of spreading infections between the already weak patients ("Copper in hospital rooms may stop infections", 2017). In general, the architecture enhances safety measures based on the experiences described in healing architecture (Ronald et al., 2002) (Frandsen et al., 2011).

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# Interior design elements influence on users' wayfinding capacity in a Swedish hospital setting

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## Abstract

Wayfinding has been recognized as an important aspect that should be carefully considered, especially in the design of healthcare facilities. Previous studies have identified environmental elements that influence wayfinding, but there is still a lack of understanding on which properties of environmental elements and features that has the potential to aid wayfinding in hospital areas (Pati, Harvey, Willis & Pati, 2015). This pilot study examined the potential of interior design elements (including artwork) to support the participants' ability to navigate in one of the reception halls at SUS Malmö hospital. In order to focus on the wordless wayfinding capacity, two subject categories were participating, 1) Arabic speaking visitors; 2) and Swedish speaking visitors. The participants, 4 females and 7 males, responded to a questionnaire in dialogue with the researcher. The data analysis showed that artworks, plants, skylight, furniture, wooden material on walls, and a tilted reception cube were the most eye catching physical elements associated with wayfinding. Written signs were seen as helpful but sometimes useless due to the fact that they are written only in the Swedish language, whereas artworks was the common language between most of the participants and therefore interesting to further explore. Since the majority of the participants disliked the artworks in the reception hall, the influence of aesthetic preferences on wayfinding could possibly be a fruitful path of further investigation.

*Keywords: wayfinding, hospitals, interior design, aesthetic preference, artwork.*

## Introduction

Wayfinding is people's ability to orient and navigate from place to place without missing the destination (Passini, Rainville, Marchand, & Joannette, 1998). It is related to people's immediate perception of space as well as their previous spatial knowledge (Roux, 2014). Today, wayfinding is a problem in the complex building, especially in health care facilities (Carpman & Grant, 2001). Pati, Harvey, Willis, & Pati (2015) states that wayfinding need more attention in healthcare facilities, and that there are few studies that investigate the influence of interior design elements on wayfinding. When disorientation occurs people get anxious and stressed, which affects their well-being (Lynch, 1960; Carpman & Grant, 2001). The physical environment in hospitals is important because of its effect on the healing

process and the well-being of patients, visitors as well as staff (Huisman, Morales, van Hoof, & Kort, 2012).

Complex environments that do not facilitate wayfinding often lack readable environmental features (Raubal & Egenhofer, 1998). One main observation is that people need visual cues such as maps, directions, and symbols to guide them to their destination and thus to enhance wayfinding (Lynch, 1960; Huelat, 2007). Pati et al. (2015) have studied which visual cues in the physical environment that participate in fostering wayfinding and they have categorized these visual cues into: *primary navigational cues*, *supporting navigational cues*, and *familiarity markers*. In this study, Pati et al. (2015) found that besides common and obvious guiding elements (primary navigational cues) such as maps, signs, and architectural features; and elements that match images from memory (supporting navigational cues) such as functional clusters, structural elements and furniture; there was also a wide range of other design elements that functioned as anchor points or landmarks (familiarity markers) such as artworks, informative panels and display boards, fixed furniture, wall colour, plants, and vending machines. Among all these other design elements, artworks were associated with the highest frequency of using as a physical element as a familiarity marker or landmark to enhance wayfinding (Pati et al., 2015). However, besides Pati et al. (2015, pp. 51- 64), research on how artworks can be used to improve wayfinding is scarce. The outcome of the pilot study, presented in this paper, calls for further research on this subject, and an attempt to address this lack in the future.

## Aim and objectives

In this paper I will discuss a pilot study made in 2015 as part of my ongoing PhD project. The aim of this pilot study was to examine the potential of artwork and interior design elements to support people's ability to navigate in one of the reception halls at SUS Malmö hospital. The study includes a questionnaire, an on-site interview, and a photographic documentation, addressing two main questions: 1) What aspects of the physical environment aid in wayfinding decision making? 2) What role does the design of the interior environment play in the wayfinding process? The study included two subject categories: Arabic speaking visitors; and Swedish speaking visitors. The choice of Arabic speaking participants was made due to the fact that a large number of Arabic speaking immigrants has sought refuge in Sweden during the last year. For people like these, who do not speak the Swedish language and therefore cannot make use of written signs, the impact of the physical environment on the wordless wayfinding capacity is especially crucial.

## Theoretical background

### The Wayfinding process

The skill of wayfinding emerged from an essential human need to find food and water, to shelter and to avoid danger (Ingold, 2000; Careri, 2002). Wayfinding can be understood as a process (Arthur & Passini, 1992; Golledge, 1999), as an ability (Downs & Stea, 1977); and as an interaction between human and the environment based on spatial knowledge and memory (Golledge, 1999). Wayfinding is the procedure of locating and following a route to reach a destination (Golledge, 1999), a procedure in which one is faced with the surrounding environment and thereafter

remembers it (Arthur & Passini, 1992). “*Way-finding is a cognitive and behavioural process*” (Raubal & Egenhofer, 1998), and it is a “*purposeful, directed, and motivated activity*” (Golledge, 1999). Finally, wayfinding according to Passini (1984), is a process that includes information processing, decision making or planning, and decision execution. Information processing is associated with the built environment features and elements which take the main role in influencing people’s perception. Therefore people make their cognitive maps based on the knowledge that they acquire from the physical environment in order to make a decision to track their destination. The decision that is taken needs to be executed in order for the person to reach the desired destination (Passini, 1984) as shown in figure (1) below.

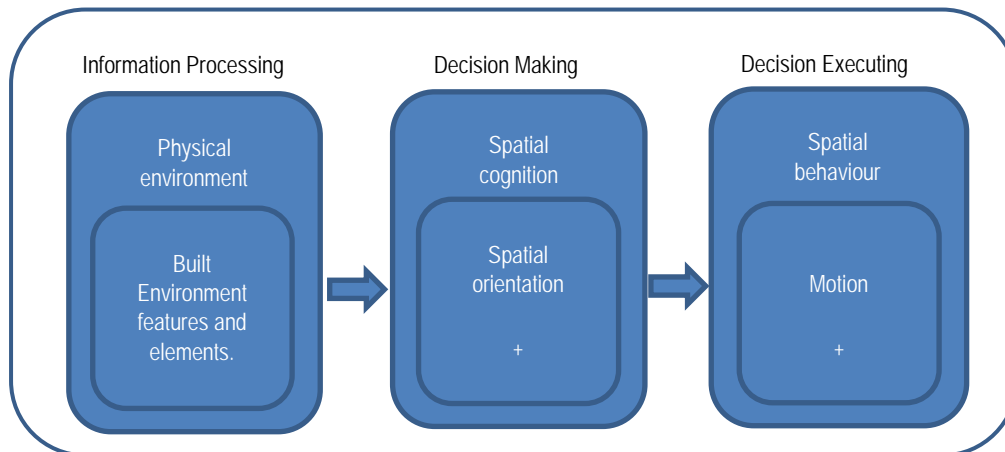


Figure 1. Wayfinding process

To further clarify the definition of wayfinding we need to look at some terms that are often used within the wayfinding literature: Orientation, Navigation and Cognitive Maps. These terms are considered to be integral parts of the wayfinding process and each one has its own function within this process to achieve wayfinding. Orientation is the determining of the person’s position in relation to a set of surroundings and other locations (Downs & Stea, 1973). Information about position, direction, destination and rout planning, which are associated with the concept of orientation (Harper and Green, 2000), are considered a primary step towards starting navigation (Golledge, 1999). Navigation is related to the action of walking through a space, while wayfinding is the cognitive process of identifying and choosing a route which leads from an origin point to a destination (Golledge, 1999). The knowledge gained from the perceived environments is presented as a cognitive map (Tolman, 1948). A cognitive map is an “*overall mental image or representation of the spaces and the layout of a setting*” (Arthur & Passini, 1992). Lynch (1960) describes the cognitive map as an image held in the mind, in other words, it is a person’s internal reflection of the outer physical environment (Golledge, 1999; Galloti, 2008), where the term physical environment refers to all natural and man-made features of the environment that limit and facilitate people’s movements (Lawton, 1970) and hence affect their wayfinding.

### Legibility and imageability

The interaction between people and the environment when finding ones way depends on our senses (Lynch, 1981). How we experience and interpret different sounds, smells, and visual elements is dependent on our physical and mental status as well as our social and cultural background (Lynch, 1981). Some people rely most on vision, while other people rely more on other abilities, such as hearing or smelling. According to Lynch (1960) the

physical environmental features, which are read or analyzed by people when experiencing an environment, could be categorized into three types of elements: *identity*, *structure*, and *meaning*. These elements are important for creating a *sense of place* that in turn can aid people to find their way, which creates a sense of control (Lynch, 1960).

Initially Lynch (1960) focuses on the sense of place through two elements: structure (the relation between physical elements) and identity (the physical element's distinction from each other). Lynch (1960) puts less emphasis on the meaning element because of its relation to time (history), people's background (society and culture), and people's emotions (Lynch, 1981).

The meaning element is however also embedded in the structure and identity elements by people's sense of *legibility* (Lynch, 1981). How easy it is for people to perceive and understand an environment depends on the readable features of its environmental structure, in other words, the environment's legibility (Lynch, 1960). Legibility is "*the degree of distinctiveness that enables the viewer to understand or categorize the contents of a scene the greater the legibility the greater the preference*" (Bell, Greene, Fisher, & Baum, 2001). At the building scale legibility can be described as the environmental affordances that foster the wayfinding process (Wiseman, 1981). An environment's visual quality depends on the shape, colour, and arrangement of its physical elements, and this visual quality determines and reinforces the environment's degree of legibility. The environmental richness of memorable and legible elements enhances spatial cognition and facilitates wayfinding (Kosslyn, 1975; Wiseman, 1981; Haq, 2001). This definition implies that there is a strong relation between the physical environment and wayfinding. In other words, the physical environment can influence people's cognitive maps and subsequently affect their wayfinding behaviour (Long, 2007). Wiseman (1981) argues that the "*legibility of the environment in complex buildings depends on environmental variables such as signs and numbers, architectural differentiation, perceptual access, and plan configuration*".

Lynch (1960) studied how the features of a place affect people's perception of it, in other words, how people perceive the environment. During this investigation people were asked to draw sketch maps from their memories based on what Lynch calls *imageable* elements: that is the common features of the environment that people use when forming a coherent mental image – a cognitive map. Furthermore, imageability is dependent on two aspects: the physical and the cultural. The first one defines location and appearance, and the second concerns meaning and association (Bell, Greene, Fisher & Baum, 2001). The physical imageable elements, used by people to aid their wayfinding, are categorized by Lynch (1960) as: *paths*, *landmarks*, *districts*, *edges*, and *nodes*. The characteristics of the physical environment hence have the role to define what Lynch calls *imageability* (Lynch, 1960).

The literature above indicate that the quality of the physical environment (shapes, colours, and arrangements) determine the degree of legibility of a built environment, and that this in turn help people to form cognitive maps that influence their wayfinding (Lynch, 1960). In this paper I will put emphasis on two of Lynch's (1960) imageable elements: landmarks and nodes. I have particularly chosen these two elements since they act as external references points and strategic foci that help people to find their way. Nodes are focal points and intersection places where people need to make a decision on how to reach their destination. While landmarks are physical features of the environment that attracts attention and are easy to remember. Landmarks are also associated with decision points, which are nodes where people have to choose which destination to follow (Lynch,



1960). According to Pati et al. (2015, pp. 59-64) landmarks are closely related to the concept of familiarity markers, but whereas landmarks are traditionally considered to be visually dominating objects, familiarity markers can be a wide range of different interior design elements that function as landmarks even though they are not necessarily visually dominant. In Pati et al.'s study (2015), mentioned in the introduction, artworks were found to be associated with the highest frequency of using an interior design element as an anchor point or landmark to enhance wayfinding, which is interesting since the pilot study discussed in this paper examined the potential of interior design elements (including artworks) to support people's wayfinding. I believe that the other imageable elements mentioned by Lynch, such as paths, edges, and districts, do not contribute to the analysis of my pilot study in the same direct way as nodes and landmarks do, and hence I have decided to set these three elements aside in this particular paper.

## Materials and method

### The study setting

Hospitals have an important role in the healthcare system. Studies imply that the very design of hospital's can improve patients' well-being, patient recovery (beside the medical treatment), patient safety, and reduce stress and anger among the staff (Ulrich, Zimring, Quan, Joseph & Choudhary, 2004). This is also true of good wayfinding design, since this is a key factor in reducing stress and anxiety in patients and visitors (Passini & Arthur, 1992).

My pilot study, which is the material for this paper, focused on the influence of interior physical elements on people's wayfinding in one of the reception halls at SUS Malmö hospital. The place of study was chosen due to its interior design, which offered a unique setting of physical features that might promote wayfinding through this node place (Lynch, 1960). The reception hall contains several types of physical elements such as artwork, plants, furniture, skylight, and many exits as well as many openings, as shown in Figure (3). The idea was that the variety of physical elements might support the pilot study in providing me with valuable information on how different physical elements impact the participants' ability to find their way within the architectural space of the reception hall.

The hospital consists of four buildings: A, B, C, D and the emergency building E (building B and D are linked through a bridge). My study site is located at building D in the ground floor in front of the X-ray department. The participants' destination is the surgery department at the third floor of building B. The reason for choosing this destination is the strong relationship between these two departments in the medical field. Figure (2) shows the buildings, the entrances, the destination (surgery department), and the study site location at the SUS hospital in Malmö.

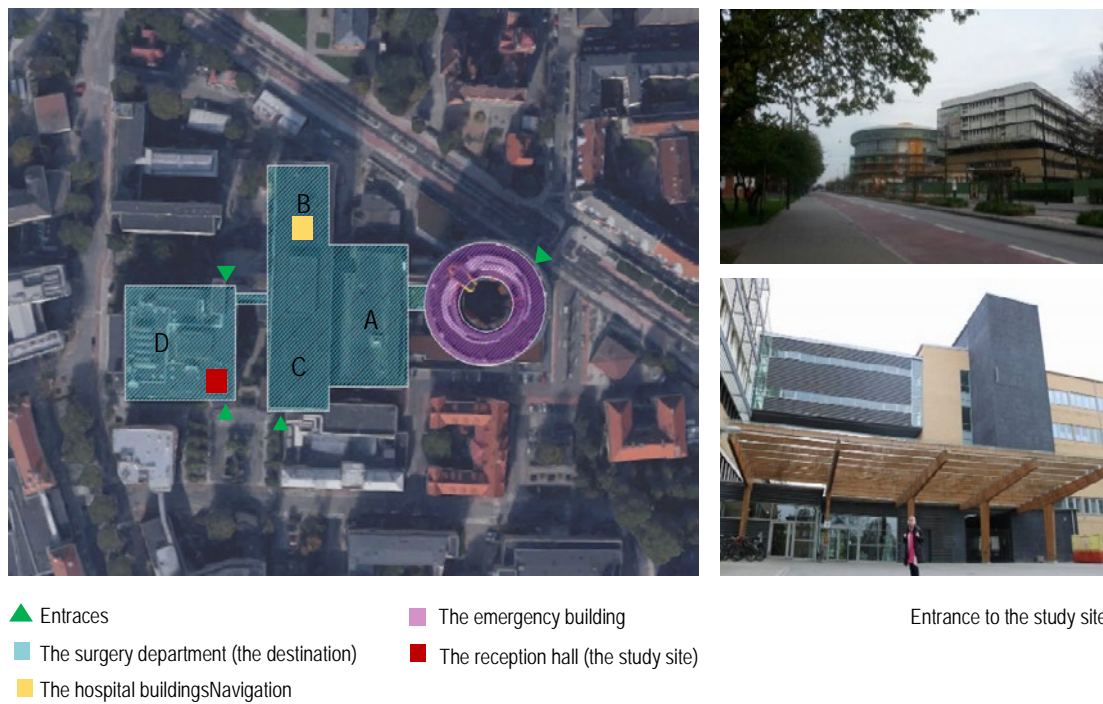


Figure 2. SUS Malmö hospital

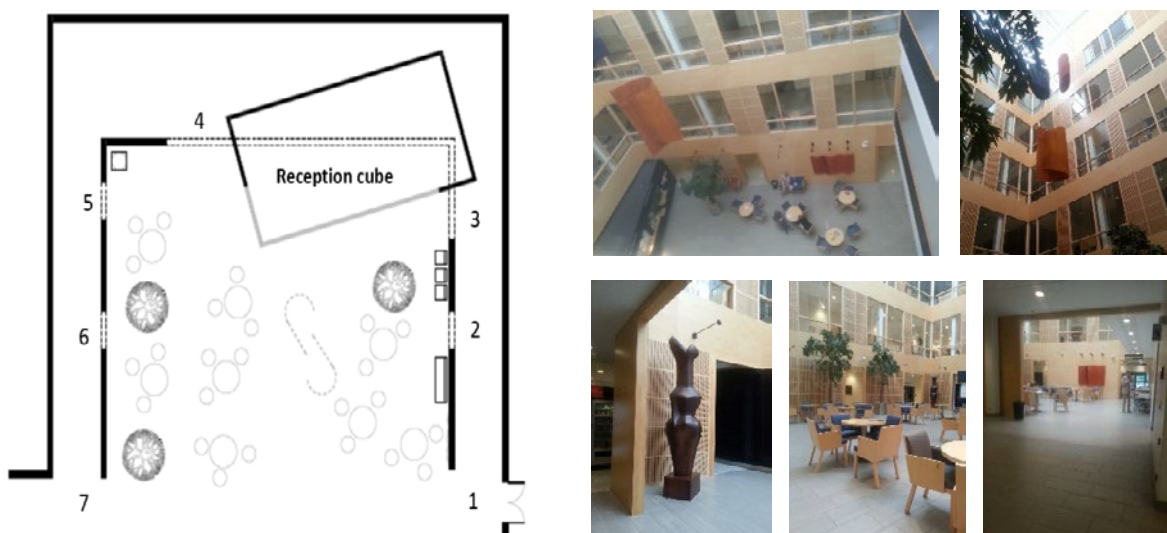


Figure 3. The plan and the interior design of the reception hall at SUS Malmö hospital.

In order to focus on the wordless wayfinding capacity, two categories of subjects participated in my pilot study: six persons speaking Arabic and five persons speaking Swedish. (One of the participants speak both these languages. In my study this participant is counted as a Swedish speaking person because she was born in Sweden 29 years ago) I chose to focus on these languages since a large number of Arabic speaking refugees have recently moved to Sweden and do not yet speak the Swedish language so well (if at all). In my study the Arabic speaking participants' had been living in Sweden for different ammounts of time. All of them (except the one who was born in Sweden) had been living here between 1,5 – 2 years. By chosing these two groups of participants I could test the impact of the physical environment on people's ability to find their way, by making a comparison between Swedish speaking respondents, who can rely on informative signs to find their destination, and Arabic speaking respondents, who can not use informative signs for their wayfinding. The respondents consisted of 11

visitors: 4 females and 7 males. The main conditions were 1) the respondents should not have visited the study setting before; 2) the respondents had to stay and experience the visited reception hall before responding to a questionnaire.

### **The questionnaire and the additional on-site interview**

The questionnaire is a quick and efficient way of collecting data through both open-ended and close-ended questions. It is also a method that is familiar to most people, and it is relatively simple to use (Robson, 2002). The questionnaire consisted of three parts: each part focusing on different aspects of the study. The first part included general information such as occupation, gender, nationality, and knowledge of art. The second part enquired about the studied place itself, particularly asking how the participants perceived various physical elements in the reception hall, such as its interior design, art, furniture and exits. The third part concentrated on wayfinding within the reception hall, for instance what elements that complicate or facilitate wayfinding.

In order to get further insight into people's experiences of the physical environment, and to further clarify some of the questions that were found difficult to understand due to language problems, I decided to also make a qualitative on-site conversation interview in addition to the more rigid questionnaire (Kvale, 1996). It was conducted when the participants were answering the questionnaire and it was based on the participants' responses to this questionnaire. The additional on-site interview was documented by taking notes at the interview situation.

### **Execution**

The questionnaire and the additional on-site interview were carried out at two occasions; weekend and workday. In the weekend the main entrances to the studied place are closed. Because of this the participants had to go through a complicated route to reach the reception hall. While in the work day it was easy for them to reach the reception hall directly from the main entrances.

The respondents answered a variety of enquires relating to the interior design elements influence on their wayfinding in the studied reception hall. The questionnaire included both close-ended and open-ended questions. The close-ended questions had a rating scale that was graded; strongly agree, agree, neutral, disagree, and strongly disagree. The open-ended questions allowed the respondents to include more information on feelings, attitudes, and understanding of the place. The additional on-site interview was made through asking further questions that were based on the respondents' answers to the questionnaire, such as: why do you feel that the artworks' placement confuses you?; or, why do you dislike the use of wooden material on walls? Perhaps that conducting the on-site interview at the same time as the respondents' were answering the questionnaire affected their responses somehow, but I believe that the value of getting deeper access to the respondents' experience, by asking them further questions of the studied place, outweighs this risk.

### **Findings**

My analysis showed the following findings:

1. The most eye catching physical elements were artworks, plants, skylight, furniture, wooden material on walls, and the tilted reception cube.
2. The most helpful elements of the interior design, aiding wayfinding, were signs and artworks. And, the elements of the interior design that made wayfinding difficult were furniture arrangements, and the numerous doors.
3. The most chosen exit was exit number seven, and the alternative choice instead of exit number seven was exit number one. While the least chosen exit was exit number four.
4. The majority of the participants disliked the artworks in the reception hall. Whereas most of the participants agreed that the interior design elements worked well together.

### Eye catching physical elements and most helpful interior design elements

The first part of the questionnaire included general information such as occupation and familiarity with art. Even though this information was not the focus of my study, but merely background information, I found the responses interesting and will therefore in this section include them in my findings. The same goes for answers where the participants' cultural background may have affected their response. It was not the outset of my study to look at cultural differences but in some of the responses this was clearly noticeable and I will therefore include this in my findings.

The participants' occupations and familiarity with art split up the participants in the questionnaire into four categories: 1) people whose profession relates very much to art, architecture and interior design, 2) people whose profession relates somehow to art, architecture and interior design, 3) people who are familiar with art, architecture and interior design, but their profession is not related to this, 4) people who are not familiar with art, architecture and interior design and whose profession is not related to this. The first category included one Arabic speaking and one Swedish speaking respondent, in the second category there were only one respondent and this respondent spoke Arabic, in the third category there were two Arabic speaking and three Swedish speaking respondents, and the fourth category included two Arabic speaking and one Swedish speaking respondent.

The second and third categories above recognized the artworks in the reception hall at the beginning of the task. Based on that, the participants found their way through perceiving and following the artworks. The first and fourth categories found their way with the help of many different types of interior design elements, such as artworks, plants, skylights, furniture, the wooden material on the walls, and the tilted reception cube (see table nr. 1 below). As an example, one of the participants was a fire engineer. The first element that caught this person's attention was the wooden material on the walls. This attention was related to safety issues, responded the informant. In case a fire would break out inside the reception hall the wooden material would speed up the course of the fire and help to expand it to the other floors.

Table 1. Eye catching interior design elements ("What perceived elements in the place catch your eye?").

Interior design elements	Arabic speaking	Swedish speaking
Artwork	3	1
Plants	2	1
Skylight	2	1
Furniture	2	0
Wooden material	2	0
Tilted reception cube	1	0
Nothing	0	2

Signs and artworks were mentioned in the study as helpful interior design elements in guiding the respondents' wayfinding. In the second part of the questionnaire no one mentioned the signs as a physical element that caught their eye based on the question "What perceived elements in the place catch your eye? Why?" (see table nr. 1 above). In the third part of the questionnaire there was a question asking about "What elements of the interior environment do you find most helpful in aiding your wayfinding?" and here four Arabic speaking and one Swedish speaking respondent (from all the four categories) mentioned informative signs as the most helpful, but the Arabic speaking respondents mentioned that the signs would only help them in case they were written in a language that they could read. Four Arabic speaking respondents from the first and the third categories and one Swedish speaking respondent from the fourth category mentioned artworks to be the most helpful environmental cues. And lastly, two Swedish speaking respondents (from the third category) mentioned nothing that was helpful to them (see table nr. 2 below).

Table 2. The most helpful interior design elements in aiding wayfinding ("What elements of the interior environment do you find most helpful in aiding your wayfinding?").

Interior design elements	Arabic speaking	Swedish speaking
Artwork	2	2
Signs	4	1
Plants	1	0
Tilted reception cube	1	0
Nothing	0	2

Interior design elements that obstructed the participants' wayfinding were furniture arrangements and the many doors. Two Arabic speaking participants (from category one and three) thought that the furniture was distributed randomly within the space which made the navigation through the place difficult for the respondents, and the repetition of the many doors confused the participants. One suggestion that came forward in the questionnaire was to merge some exits, for instance to merge exit number two and number three, to create a bigger and more obvious exit that would help the participants to find their way, instead of as now getting lost because of the many different doors.

## Most chosen exits

The second part of the questionnaire included questions about the most preferred and the least preferred exits for reaching the surgical department from the reception hall. Exit number seven and exit number one were the most chosen exits. These choices were based on the physical environmental features of these exits. Most participants (6 out of 11) chose exit number seven as their first choice. This was because the staircase (a physical element) that leads to the next floor where the end destination (the surgical department) is situated was clearly visible through exit number seven, which enhanced the respondents' ability to find their destination through that exit. Exit number one was the respondents second alternative (5 out of 11) and this was for three reasons: firstly, the participants entered the place from exit number one; secondly, the participants felt that exit number one seemed to lead the way into the hospital in an easier way than exit number seven, this since the main entrance of the hospital was clearly visible through exit number seven and this main entrance leads outside the hospital and not into the surgical department. Thirdly, exit number one has an exit sign. Furthermore, one of the participants had a different wayfinding routine than the others: he always chose the door next to his right hand without specifying one of the exits as the most chosen. He always does this, because from his perspective it makes it easier for him to remember how to return if he loses his way. The reason for this behaviour was a habit rooted in his religion (Islam). The least chosen exit was exit number four (5 out of 11 participants choose this to be the least useful exit), this because the respondents thought that this exit seemed too private and also that it might lead to a dead end, which made the participants feel uncertain about its destination.

## Aesthetical preferences of artwork and interior design

Eight participants (from all the four categories) expressed that they thought it was unusual to find artworks inside places that are for medical treatments, such as health-care buildings. Seven participants (from the first, third, and fourth categories) agreed that the elements of the interior design worked well together. At the same time, six of them disliked the artworks in the place. The material of the artworks seemed strange somehow from the participants' perspectives, and the size and placement of the hanging artwork confused some of them. The orange colour of the artwork attracted two respondents from the first and third categories, since they felt that this colour had the principle role of catching the eye. The wooden material on the walls, the furniture, the skylight, and especially the plants made four of the participants remember nature environments from their homelands (Iraq and Syria). Because of the skylight's inlet of daylight two of the participants also experienced the place as bigger than it actually is.

## Discussion

People's wayfinding abilities and behaviours are not one and the same. Some people depend on maps and signs for their wayfinding, or prefer verbal communication to find their direction, and other people are depending on visual cues such as signs, artworks, furniture, interior design elements, and other visual features of the physical environment for their wayfinding. In this study, there are individual differences such as people's occupation, their familiarity with art, their culture, and their language that affected the wayfinding decision making process and the physical movement within the studied space.

The participants in my study had different native languages: Swedish and Arabic. This affected their wayfinding possibilities in that informative signs were only written in the Swedish language. At the beginning of the pilot study my intention was to look at the differences between Swedish and Arabic speaking participants in terms of their wayfinding capacities, but the differences in understanding the Swedish language between the two groups did not provide me with more information than what is mentioned above. In addition I found that the participants' background (their occupation and familiarity with art as well as their culture) affected their perception of the environment in more profound ways, which in turn influenced their wayfinding. For example one participant always relied on his right hand to choose an exit to use based on his religion (Islam), and some participants noticed the plants since they evoked memories of the nature environment in Iraq and Syria where they used to live before moving to Sweden.

The pilot study, described in this paper, found that many different physical elements in the studied reception hall at SUS Malmö hospital a node place where the participants need to make a decision before moving on to their destination caught the navigating participants' eyes as landmarks that provided them with useful information for their wayfinding. In other words, these readable features of the physical environment enhanced the environment's legibility and made it easier for the participants to find their way. The different readable features, or imageable elements in Lynch's terms, found in my study include artworks, plants, furniture, skylights, wall material, and the tilted reception cube. These imageable elements affected the participants in different ways in that both positive and negative emotions and experiences tied to the physical environment were found in my study. For instance, the artwork was experienced as impressive in a positive way to some participants, since they were not used to see artworks in hospital environments. Other participants thought that the artwork was huge, and also ugly because of its odd material (sackcloth) and placement, and this made them confused. However, the artwork was functional as a landmark regardless of whether the participants liked or disliked it aesthetically.

## Conclusions

The studied reception hall is a node place with legible features that were easy for the participants to notice and remember when selecting a path to follow, such as: signs, exits, artworks, plants, skylight, furniture, wooden material on walls, and the tilted reception cube. Out of these legible features signs and artworks were the most helpful landmarks in aiding the participants' wayfinding. Lynch (1960) states that landmarks provide the environment with orientation cues that aid participants' wayfinding. In my study artworks were the most attractive landmarks in that they were recognizable and usable as orientation cues to many different participants, even non-Swedish speakers. Interestingly enough, the majority of the participants in my study disliked the artwork in the reception hall, but this dislike of the artwork did not affect its role as a visually dominant landmark. Regardless whether they liked or disliked the artwork, it was still a memorable element that aided the participants' wayfinding. This is an interesting finding that opens up for further investigations, where the influence of aesthetic preferences on wayfinding would possibly be a fruitful path.

## Thoughts for the future

Visual art in healthcare environments have the potential to moderate patients' stress levels and to aid their wayfinding (Rollins, 2011). Ulrich and Gilpin (2003) argue that the type of art that is used in hospitals should be chosen based on its potential to promote emotional responses, reduce anxiety, and relieve stress, and it should not be chosen based on its praise from art critics and artists or from museum norms for quality. According to Eisen, Ulrich, Shepley, Varni, & Sherman (2008) different types of art supports stress reduction to different extents: where art depicting natural environments reduce stress, pain, and anger, and increase satisfaction to a greater extent than more abstract arts. The physical environment in hospitals can also lead to stress, confusion and worry (Stankos & Schwarz, 2007; Rollins, 2011). For instance if you cannot find your way. When choosing art for health care environments the arts wayfinding capacity should therefore not be overlooked. Additionally, it might be interesting to experiment with the issue of what type of artwork that function as landmarks and which type of artwork that does not, and especially to examine how people's different aesthetic preferences affect this issue.

## Limitations

The limitations of this study are evident. The first limitation is on an educational and gender level: the participants have a high educational level (Master and PhD student), which may affect the questionnaire responses, due to their homogenous background. The second limitation regards the types of artworks and their placements, in that there is little variation inside the reception hall. The third limitation is the Arabic speaking respondents in the sample have been living in Sweden for different amounts of time, making it hard to evaluate the cultural differences among the Arabic speaking respondents as well as the cultural differences between the Arabic speaking and the Swedish speaking informant groups. In addition, the number of participants in the study were small and hence it is not possible to generalize the results of the study.

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# Beyond the dichotomy of figurative and abstract art in hospitals: the potential of visual art as a generator of well-being

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## Abstract

*Within the evidence-based design discourse, and deriving particularly from the theory of emotional congruence, abstract art has been indicated as unsuitable for hospitals. As patients may often experience unfamiliarity, vulnerability, stress, unpredictability and uneasiness in hospitals, these negative factors in terms of patients' well-being are predicted to be detrimentally reinforced by abstract art, but alleviated by particular forms of figurative art. The present paper focuses particularly on this question of the suitability of abstract art in Danish hospital settings and presents findings from two experimental case studies on 98 patients' well-being in relation to their experience and use of visual art during hospitalization.*

*The case studies employed a mixed-method approach, including interviews and observations informed by thermal video recording, surveys and psychophysiological experiments.*

*Six experiential domains are employed to understand the notion of experience of 'well-being': Space, Time, Inter-subjectivity, Body, Mood and Personal identity.*

*The hypothesis that the ambiguity of abstract art leads to stressful effects is not confirmed by the study's findings. The studies are developed to qualify current guidelines for the application of art, which emphasize a dichotomy between figurative and abstract art. While confirming the positive effects of figurative art, the studies indicate that the ambiguity of meaning in abstract compositions can also facilitate patients' memories, thoughts and feelings, addressed as experiential domains of well-being.*

*Keywords: health environment, healing arts, well-being, phenomenology, mixed-methods*

# Background

Studies on the effects of hospital environments on quantifiable patient health-outcomes, often leave patients' experience of well-being under-examined. Research framed within physiological and/or psychological perspectives, has applied theories such as *biophilia* (Wilson, 1984), *distraction* (McCaul & Malott, 1984) and *emotional congruence* (Bower, 1981; Singer & Salovey, 1988). Deriving particularly from the theory of *emotional congruence*, abstract art has been indicated as unsuitable in hospitals (Ulrich & Gilpin, 2003). This stance is motivated on the grounds that the ambiguity of meaning in abstract art is too open-ended for patients to interpret. As empirical studies in patients' experience of hospital environments have found states of unfamiliarity, vulnerability, stress, unpredictability and uneasiness (Nielsen et al. 2016; Terkildsen, 2007; Timmermann, 2014), the logical conclusions drawn from studies of this nature are that these factors will promote the projection of negative states of mind and mood onto abstract art (Ulrich, 2009; Ulrich & Gilpin, 2003).

It has been argued for many years that the context of nursing care plays a significant role in relation to patients' well-being (Birkelund, 2011; Martinsen, 2006; Rogers, 1970; Watson, 1985). However more recent studies in the field of well-being indicate a shift towards including considerations on how identifiable factors in the physical hospital environment may also effect patients' experience of well-being, relief and positive emotions (Bauger & Bongaardt, 2016; Olausson, Lindahl, & Ekebergh, 2013; Timmermann & Uhrenfeldt, 2015). It is within this research focus that this paper is situated, where artworks are considered as an affective part of the physical environment and as an element towards the experience of well-being.

# Introduction

The paper draws from a number of experiments in the laboratory and natural settings of healthcare environments carried out in the period 2015-2016 under the title "The Potential of Art in Hospitals". Drawing from these studies, this paper will focus particularly on the question of the suitability of abstract art in Danish hospital settings. Based on results of two experimental case studies on patients' experiences and uses of visual art during hospitalization, we seek to develop the language of discourse of art as a potential generator of well-being in hospitals. We will argue that rather than being rooted in the dichotomy between figurative and abstract art, as current guidelines recommend, art and art strategies for hospitals can be informed by concepts such as Space, Time, Inter-subjectivity, Body, Mood and Personal identity and be used as an integrated tool for healing.

## Theoretical Framework

Framed by an overall phenomenological approach, the study approaches the notion of 'being well' and how patients use and experience art during hospitalization (Heidegger, 1962; Ingold, 2000). The understanding of well-being is further inspired by recent theories of the concept as an experiential phenomenon articulated within a multiplicity of possible states of being (Galvin and Todres, 2011). Departing from these ideas, six experiential domains are deployed, which allow well-being to be understood as a phenomenon that can be experienced spatially, temporally, inter-subjectively, bodily, in mood, and in terms of the experience of personal identity.

# Method

The paper presents findings from two experimental case studies on patients' well-being in relation to their experience and use of visual art during hospitalization. The case studies employed a mixed-method approach, including interviews and observations informed by thermal video recording, surveys and psychophysiological experiments (Baceviciute et al., 2016; Folmer & Nielsen, 2016; Nielsen et al., 2016).

## Settings

The two qualitative experimental case studies were carried out in 2015 (spring/autumn) in the natural environment of two hospitals.

The first case study (case study 1) was carried out in the dayrooms of five medical wards in Jutland, Denmark (Sygehus Vendsyssel, Hjørring): specifically, wards for 1. Cardiac patients, 2. Elderly medical patients, 3. Lung patients, 4. Gastro patients, and 5. General internal medicine patients. The dayrooms were primarily used by patients who wanted a change of scene from their shared patient room in the ward. Here they could read, watch television, eat their meals and socialise with co-patients or relatives. In general, patients were hospitalized here for between 1-3 days.

The subsequent case study (case study 2) was carried out in fourteen single-bed patient rooms of two interrelated wards in one hospital in the Zeeland area of Denmark (Regional Hospital, Glostrup). The wards were located on the same floor of the hospital. A common group of staff treated and monitored the patients with respiratory distress of various kinds. During hospitalization, patients rarely left their patient rooms, which was used for sleeping, eating, reading, socialisation, examinations etc. Each room had its own private bathroom. In general, patients were hospitalized here for between 1-2 days.

## Participants

Thirty hospitalized patients situated in case study 1 and sixty-eight patients in case study 2 were interviewed, while a larger sample was observed.

In general, the interviewed patients in case studies 1 and 2 shared some basic social, cultural and physical characteristics. All participants in case study 1 lived in the northern part of Jutland; the thirty interviewed patients were aged 62 on average, ranging in age from 41 – 91 (cf. Table 1). The participants were predominantly married with children and trained in tradecrafts or agricultural work. All participants were physically mobile and appeared cognitively clear-headed, with the exception of one patient. All observed participants were adult patients ranging from approximately 20 - 90 years, appearing with the same physical and cognitive states as most of the interviewed patients.

Table 1. Interviewed patients – Case study 1

Patient no.	Ward no.*	Gender	Age	Place for interview	Interview duration
Week 1					
1	1	Male	50	Dayroom	25.21
2	1	Male	54	Patient room	29.55
3	1	Male	62	Dayroom	23.58
4	3	Male	64	Dayroom	19.20
5	1	Male	83	Patient room	32.00
6	1	Female	57	Dayroom	16.54
7	4	Male	65	Patient room	43.17
8	4	Female	46	Patient room	26.01
9	4	Female	50	Patient room	33.40
10	1	Female	61	Patient room	18.09
11	3	Female	63	Patient room	21.03
12	1	Male	52	Patient room	33.44
13	1	Male	53	Dayroom	13.29
14	1	Male	68	Patient room	12.20
15	4	Female	76	Patient room	32.09
Week 2					
16	1	Female	63	Dayroom	24.30
17	1	Male	75	Dayroom	16.19
18	4	Male	52	Dayroom	16.34
19	3	Male	64	Dayroom	19.29
20	4	Female	61	Dayroom	27.07
21	1	Male	52	Dayroom	19.47
22	2	Male	91	Dayroom	08.14
23	1	Female	68	Dayroom	21.14
24	1	Female	86	Patient room	25.31
25	1	Male	72	Patient room	42.36
26	1	Male	41	Dayroom	16.57
27	5	Female	53	Dayroom	15.30
28	4	Female	68	Dayroom	24.01
29	3	Male	63	Patient room	30.28
30	1	Female	58	Dayroom	22.35

\* Ward and patient type: 1. Cardiac patients - 2. Elderly medical patients - 3. Lung patients - 4. Gastro patients - 5. General internal medicine.

Generally, patients in case study 2 were hospitalized in one of the two wards in order to monitor their respiratory distress. A questionnaire carried out during case study 2 (Folmer & Nielsen, 2016) shows that almost 80% of the patients had a tertiary or secondary education. 60% were married or in a

relationship and 40% were single. Most of the patients suffered from complex apnea (40%) and 12% suffered from post-polio effects. The rest suffered from other respiratory implications such as ALS, KOL and the Cheynes-Stokes condition. For most of the patients, it was not their first visit to the particular ward under study (98%); 40% of the patients had been hospitalized more than 10 times before. On this note, participating patients from this study were experienced visitors of the hospital. The exact distribution of interviewed patients on ward and gender is showed in Table 2.

Table 2. Interviewed patients – Case study 2

Ward	No	Gender	No
A	19	Male	45
B	49	Female	23
In total	68	In total	68

We not taken any further consideration to the diagnostic background of the patients involved in the experiment.

## Procedure

Case study 1 included an initial user-oriented study, which ranked twenty paintings (Nielsen et al., in press). This was followed by an experiment using the four most and the one least popular (ranked) paintings, and which were mainly figurative in nature, in the dayrooms of the five medical wards. Fieldwork was done in the comparative dayrooms, over a two-week period. During the first week, dayrooms were configured without the presence of art; in the second week they were configured with the selected five artworks. Thirty semi-structured interviews were carried out with patients – fifteen each week (cf. Table 1.). Observations, participant observations and informal conversations were carried out in all five dayrooms. Thermal cameras monitored the usage, patient occupation and flow in two of the dayrooms to inform qualitative research and reduce bias.



Figure 1. Bare white back wall in patients' dayroom, week 1 – Case study 1





Figure 2. Painting being hung up on back wall in patients' dayroom, week 2 – Case study 1

Case study 2 employed ten posters/reproductions of visual art, of which nine were of an abstract character, in the fourteen single-bed patient rooms for respiratory distress. Interviews of sixty-eight hospitalized patients were collected in the patient rooms over the duration of a month (September 2015). A survey of forty-nine patients and a psychophysiological EEG- and eye-tracking experiment of thirty test participants was carried out to inform qualitative research and reduce bias.



Figure 3. Posters of visual art situated in single-bedded patient rooms – Case study 2

All qualitative data in terms of interviews and observations were collected by one and the same researcher, trained as an anthropologist.

# Analysis

## Qualitative Data

The appliance of semi-structured interviews allowed the participants to reflect and open up for individual experiences, emotions and thoughts (Rubow, 2003; Spradley, 1979). Informal conversations were continuously included, thereby informing the pre-prepared guide for the questionnaires (DeWalt 2002). All interviews were transcribed and carefully coded in Nvivo software for themes and categorized into more general topics following a iterative-inductive research approach (O'Reilly, 2012). Inspired by earlier qualitative studies on patient well-being (Olausson et al., 2013), an initial "bridled" reading of the transcriptions was carried out in order to understand the text on its own terms. The coding of data was then discussed in the research group and guided by themes from earlier qualitative studies on patients' well-being in relation to physical surroundings in healthcare settings (Nielsen, 2013; Timmermann, 2014), studies on art in hospitals (Nanda et al. 2011; Ulrich and Gilpin 2003) and methods for conceptualisation and perception of art (Arnheim, 1954; de Botton & Armstrong, 2013), to ensure inter-coder reliability and relate coding to the general language of the field of study.

## Quantitative Data

Thermal cameras (which do not record identifiable features of the informants) were mounted in the dayrooms to record heat radiation from people within the recording frame. White areas in the recordings represented the hottest and black the coldest areas of the frame. The video was processed in a specially designed computer program that detects areas of heat. This detection is made in each frame of the video, i.e. 15 times per second in our case. A new image for each pixel (position in the image) is recorded as 0 if there is found to be a person in the current frame or a 1 if there is not. These records were compiled over 24 hour periods. Thus, the highest number on the image is found where people are more frequently detected. For visualization every result was scaled for each day so that the highest number displayed as white and 0 displayed as black. All figures in between were scaled linearly in tones of grey (cf. Figure 4).



Figure 4: Scaled image of thermal camera recording in dayroom - Case study 1

A psychophysiological experiment was performed in The Augmented Cognition Lab at Aalborg University Copenhagen. The experiment was made up of an EEG and eye-tracking test that monitored brain activity among 30 subjects, divided into 20 men and 10 women with an average age of 24.6 years. Test subjects were presented to the 10 art posters of the main experiment, as well as 40 other works of art on a screen for 40 seconds. The test subjects were then asked to consider the various works. After another 5 seconds, they were presented with a new work (cf. Figure 5).

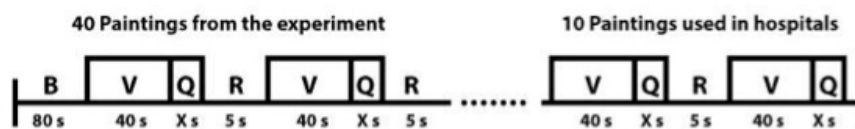


Figure 5. Experimental sequence: B – Baseline; V – Viewing of the images; Q – Questionnaire, R -Rest – Case study 2.

Each experiment session took about 90 minutes to complete, where test subjects were asked to rate their aesthetic experience of each work from categories: pleasant, unpleasant, neutral, and whether they had seen the work before (Baceviciute et al., 2016).

# Results

As shown in Table 3., coding of qualitative data from interviews in case study 1 and 2 showed the potential of visual art to address and put into play patients' notions of well-being in the six experiential domains of Space, Time, Inter-subjectivity, Body, Mood and Personal identity (Galvin & Todres, 2011).

Table 3. Extracts of qualitative data on patients' experience of well-being in case study 1 and 2, coded in relation to Galvin and Todres' six experiential domains of well-being (Galvin & Todres, 2011).

Patient Quote	Experiential Domain of Well-being	Case Study no.
A. <i>It makes a difference that the walls are covered with art... otherwise it's just all white and un-cosy. It puts you in a more comfortable mood when you are hospitalized. It's like there is something to look at... and something to build on. Something you can sit and talk about and take home with you...</i>	<b>Space</b> <b>Mood</b> <b>Personal identity</b> <b>Inter-subjectivity</b>	1
<i>It's different with this all-white room... you may as well stay in a snow cave - here is nothing to relate to and it feels very cold.</i>	<b>Space</b> <b>Personal identity</b> <b>Body</b> <b>Mood</b>	1
B. <i>It's a funny one that one (painting)... I look at it every day... one always finds something new. I noticed... the small people in the middle and behind the statue... And then there are also the whales on the right side of the boat over there. There once was a boat sailing from Copenhagen to Aalborg... you can easily make some stories out of this painting... in my younger days we caught the big tunas in Øresund that pulled up to spawn in the Baltic Sea... I fished for 10 years you know...</i>	<b>Time</b> <b>Personal identity</b> <b>Inter-subjectivity</b>	1
<i>It is great to have something else to look at, when you have finished counting all the dots in the ceiling... when you've been here for a week, you can easily get a sort of cabin fever...</i>	<b>Mood</b> <b>Space</b> <b>Time</b>	1
C. <i>I like being able to lose myself in art for a while (...) This is like the surface of the moon peeking out. You can see a feather there... and a palm tree... I am from Hawaii... So you can see palm trees and grass. It is just your imagination (that defines) what you can find. That's what I like. You have no idea what the artist was thinking while making it, so you can make your own story.</i>	<b>Time</b> <b>Personal identity</b>	2
D. <i>It's really nice that it's here (the artwork) ... It lives up in a way. For me it's just squiggles, but it's nice that it's here instead of just white walls. Colours give a different whim... It also means that you can sit and take a look at it and zone out... Yesterday I sat in the bed and knitted and looked at it a bit... I just sat and dozed and dreamed of something else... it gave me a little peace... it was also the first impression I had when I came into the room - that it included art and had a lovely atmosphere.</i>	<b>Space</b> <b>Body</b> <b>Mood</b> <b>Time</b>	2
E. <i>I've also been looking for motives in the picture ... I've spent a little time on it ... It exudes a warmth when there are colours. When I arrived I first saw the wires over there and then I looks over here and saw the combination of all the colours... And then the forest and canola fields came to me... I immediately came to think of it. At our home we have a lot of these types of fields... It infuses such peace...</i>	<b>Time</b> <b>Body</b> <b>Mood</b> <b>Space</b> <b>Personal identity</b> <b>Inter-subjectivity</b>	2

Interestingly, the potential of art to infuse a sense of well-being in patients was not indicated to be dependent on whether the art was experienced and/or used by patients in the hospital environment of the five dayrooms in case study 1 or the fourteen single-bedded patient rooms in case study 2. Thus, all six experiential domains of well-being were traced in case study 1 as well as in case study 2 (cf. a comparison of patient quote A-D and E-G in Table 3.).

In this regard, art and well-being was not significantly related to the artwork being figurative or abstract. Patients in both case study 1 (which comprised mostly figurative compositions) and case study 2 (comprising predominately abstract compositions) experienced the potential of the art to address well-being in all six different experiential domains (cf. a comparison of patient quote A-D and E-G in Table 3.).

Due to a small data set and the distribution of abstract and figurative art in case study 1, findings from thermal cameras did not significantly inform data analysis on the topic of the potential of abstract vs. figurative art. However, findings from the psychophysiological experiment supported the qualitative findings of case study 1 and 2, by showing that the liking or disliking of art was not significantly related to it being abstract or figurative (Baceviciute et al., 2016). Furthermore, the results of the psychophysiological experiment showed the viewing of abstract art to involve less demanding information retrieval, memory-related cognitive processes and less mental engagement by test subjects than the figurative (Baceviciute et al., 2016).

It is therefore concluded from these studies that abstract art has the potential to induce well-being in hospitalized patients. The notion that the ambiguity of abstract art generally leads to stressful effects was thus called into question by these findings. Furthermore, the qualitative studies indicate the potential of art to infuse a state of well-being by eliciting patients' ability to reminisce in their interaction with the artworks – regardless of these being figurative or abstract (cf. especially patient quote C, E and G in Table 3.).

## Discussion

From the results of the study, the subject of art in hospitals is expanded beyond its potential as a tool for positive distraction from pain, discomfort and stress, to include its potential to infuse an overall notion of well-being in hospitalized patients. The results stage the patient and his/her prior experiences at the core of appliance and selection of art for hospitals.

The studies qualify current guidelines for the application of art, which build on *emotional congruence theory* and which emphasise a dichotomy between figurative and abstract art (Ulrich & Gilpin, 2003). While confirming the positive potential effects of figurative art, our studies show that the ambiguity of meaning in abstract compositions can also induce relaxation and facilitate patients' memories, thoughts and feelings, addressed as experiential domains of well-being.

On the further development and application of combining the mixed methods of our study, we recommend camera recordings over a longer period of time and in contexts with a higher flow and use of space, to make the findings from this method more applicable. Moreover, more tailored-to-context studies of art in hospitals are required in future natural experiments relevant to this field of study, where qualitative studies of patients can include persona analysis and personality tests.

The natural experiment design employed includes the danger of confounding and uncontrollable factors, which may influence the results. However, the patient behaviour studied reflects a very high ecological validity, as it occurs in non-laboratory, true to life settings. It is possible that the patients of the case study have been more positively primed than a broader population of patients and than the patients addressed in former guidelines on healing arts (Ulrich, 2009). The study context of patients with relatively short hospital stays (1-3 days); extensive experience of hospitalisation; and the mainly monitoring of illness rather its diagnosis and/or treatment, sets the scene for less vulnerable, healthier, mobile, active and socializing patients.

Nevertheless, these types of patients are part of the everyday hospital environment and of a type, which may be anticipated to proportionately increase in the future, through various measures introduced by Danish healthcare to cut down hospitalisation time and the encouragement of outpatient treatment. While this reflects the limited focus of the study on a certain type of patient within the complex environment of the hospital, the study lead to the collection of large amounts of data toward more in-depth reflections of well-being. Studies are still needed on the potential effects of art on seriously ill patients hospitalized over a longer period. These studies will need to be designed with the illness of patients in mind, where their level of frailty requires interventions that are more sensitive.

The findings point to the need for a reflective exploration of the methods and theories applied in the study of evidence-based art in hospitals, in terms of qualifying the understanding of patients' experiences and uses of art in hospitals.

# Conclusion

The potential of visual art to address and put into play patients' sense of space, time, inter-subjectivity, body, mood and identity were confirmed in the data analysis. Results show how patients' overall experiences and uses of art during hospitalization act as a generator of well-being in the hospital environment, regardless of whether the art is of a figurative or abstract nature. The findings thus encourage a discourse beyond the dichotomy of figurative and abstract art in hospitals and argue for a less prejudiced approach to the matter.

Within this framework, practitioners and decision-takers may find new directions for patients' satisfaction with healthcare services that include an understanding of the existential level of well-being of patients. Furthermore, the findings support the integration of visual art as an integrated tool for healing in hospitals.

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# Feeling better: sensory rooms in an inpatient psychiatric unit

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# Abstract

*The use of sensory or 'comfort' rooms in the care of acute psychiatric patients is an area of growing interest and research, often concerned with their efficacy in helping patients to self-soothe or in reducing rates of patient seclusion or restrictive intervention (Novak et al. 2012, Champagne and Stronmberg 2004). However, it is still not well understood how patients and clinical staff make sense of the sensory elements of these rooms and the items within them, what feelings and affects they engender and how this might link sensory experience with material objects and built spaces. In this paper we draw on sensory ethnography (Pink 2015) to examine patients' narratives and demonstrations of how their experiences of and activity in sensory rooms or with portable sensory items lead to them 'feeling better', and the processes that staff engage in when seeking to enable these experiences.*

*In doing so, we analyse the recent introduction of sensory rooms in a regional hospital in Australia, and the imagined development of these for a new hospital site. We draw on a recent ethnographic study in a psychiatric services unit to explore aspects of the use and experience of these spaces, from two distinct perspectives. First, we analyse how patients and clinical staff use the existing sensory rooms, and how patients are encouraged to select and utilise particular items to create particular sensations and affects. Second, in the context of a planning a new, purpose-built facility, we discuss how the use of the future rooms was imagined and informed choices about the design, location and items within the rooms. By discussing how staff and patients both experienced the existing sensory rooms and how they imagined and planned for the new ones, we will explore how the health and well-being of hospitalised psychiatric patients is ongoingly constituted and imagined in relation to material and sensory environments.*

*Keywords: sensory experience, psychiatric inpatient unit, ethnography.*

# Introduction

In this paper we argue for an approach to the design of sensory rooms in acute psychiatric care that has at its centre attention to the unspoken, tacit, sensory, affective experiences and imaginaries of patients and staff and how these are articulated in relation to the everyday materialities and design of the built environment. The use of sensory or 'comfort' rooms in the care of acute psychiatric patients is an area of growing interest and research (Novak et al. 2012, Champagne and Stronmberg 2004), often concerned with their efficacy in helping patients to self-soothe or in reducing rates of patient seclusion (the sole confinement of a person to a room or any other enclosed space from which it is not within the control of the person confined to leave) or other restrictive interventions (any form of physical or mechanical restraint that prevents a person having free movement of his or her limbs, but does not include the use of furniture that restricts the person's ability to get off the furniture). However, it is still not well understood how patients and clinical staff make sense of and participate in the making, design or configuration of the sensory elements of these rooms and the items within them, what feelings and affects they engender and how this might link sensory experience with material objects and built spaces. In this paper we draw on sensory ethnography to examine patients' and staff's verbal narratives and embodied demonstrations of their experiences of, activity in and future imaginations for sensory rooms or portable sensory items. Throughout we will argue that patient and staff uses of these rooms, often described as being based on 'trial and error', demonstrate the importance of designing for user improvisation or innovation in the built environment.

Our discussion is based on an example of sensory rooms in the context of transition to a new hospital design at Bendigo Hospital in the Australian state of Victoria. The newly designed Bendigo Hospital was opened in early 2017, is the largest non-metropolitan hospital development in the state and serves a population of just over 300,000 people in a catchment area of almost 57,000 square kilometres (Bendigo Health n.d.). Its Psychiatric Services Unit is growing, and the new facility is designed with 80 beds – almost double the capacity before the move. In this paper we discuss the implementation of 'sensory rooms' at Bendigo Health Psychiatric Services, their introduction in the old facilities and how they were imagined and planned for in the new site.

In what follows we first outline our sensory ethnography methodology. We then draw on ethnographic research from before the move to the new hospital, in which we explored with hospital patients, staff, management and designers how they used the sensory rooms in the old site and how they imagined the new facility. We focus on how these rooms lead patients to 'feeling better', and on the processes that staff engage in when seeking to enable these experiences. In doing so, we will explore how the health and well-being of hospitalised psychiatric patients is ongoingly constituted and imagined in relation to material and sensory environments from two distinct perspectives. First, we analyse how patients and clinical staff used existing sensory rooms, and how patients were encouraged to select and utilise particular items to create particular sensations and affects. Second, in the context of planning a new, purpose-built facility, we discuss how the use of the future rooms was imagined, and how these informed choices about the design, location and items within the rooms.

# Sensory ethnography

Sensory ethnography ‘develops an approach to the world and to research that accounts for how sensory ways of experiencing and knowing are integral both to the lives of people who participate in our research *and* to how we ethnographers practice our craft’ (Pink 2015, xi). Rather than studying ‘the senses’, this approach, informed by phenomenological anthropology (Ingold 2000), involves attending to sensory perception as being integral to how people learn about, know in and engage affectively with the affordances of the everyday material and social environments they move in and through.

In practice, sensory ethnography is always tailored to specific contexts, environments and participants, and in this sense there is no single model to follow. It requires a deep researcher sensibility to seek to understand and empathise with participant experiences, and an openness to understand what it might feel like to experience the affordances of everyday worlds from another’s perspective. This of course does not mean that the sensory ethnographer can ever know what it is like to feel the world in the same way that others do, or to imagine futures exactly as they do. However, it does assume that by seeking to occupy similar material and sensory environments and to empathetically engage with other people’s realities, researchers can create ‘correspondences’ (Okely 1994) between their own and other people’s experiences. These can then help offer and disseminate insights that will help to deepen our understanding and, when combined with design ethnography principles, will also inform interventions towards new forms of wellbeing.

In the project discussed here we used a sensory ethnography approach to learn about the research participants’ experiences of being in and contributing to the constitution of, and imagining future sensory rooms, an aspect they were not often invited to discuss explicitly. To do this we spoke to key users of the rooms - staff and patients - asking them to show us how they spent time in the room, how they had arrived at the use of it that most suited them, their favourite objects, and the sensations they created in using them. We used video or audio recording to interview them, depending on their preference, and also took photographs of features of the room as they directed. It was part of a larger ethnographic study at Bendigo Hospital that investigated the design of the Psychiatric Services Inpatient Unit, and for which we interviewed 42 individual staff, patients or visitors to the old wards before the 2017 move, and some designers of the new site. In this paper, we focus on the sensory room in the adult acute unit, as it received the most use, and draw on material from a range of different interviews that took place with research participants in the room. To understand how the hospital’s approach to sensory modulation would be taken forward into the new facility, we also interviewed the staff responsible for planning and purchasing sensory equipment for the new hospital site. The empirical material below is drawn from three interviews and exemplifies some of the ways that a range of people encountered and exercised these spaces.

Our sensory ethnography approach is particularly attentive to how people actually physically and emotionally engage with their environments, that is how they ‘feel’ in and with their environments. This includes a focus on how research participants might go about changing the material or sensory organisation of things and processes as part of a project to make themselves feel ‘comfortable’, ‘better’ or as near as to feeling ‘right’ as possible. We seek to investigate ethnographically specifically how people improvise or innovate

in their everyday environments, by following a design anthropology approach that understands human improvisation as part of an ongoing process (Ingold 2013; Gunn and Donovan 2012; Gunn, Otto and Smith 2013). This can be seen as a form of 'everyday designing' in that it appreciates how ordinary people (ie, not necessarily trained designers), are actively involved in making and re-making their sensory and material environments in relation to the contingencies of the everyday, their hopes and imaginaries. Recognition of this practice of everyday design by lay users within the realm of the everyday world is a growing area of scholarship, research and design practice by designers and architects. From the ground breaking work of Donald Norman and the development of user-centred design; to the evolution of new domains of design practice led by Bill Moggridge and Pelle Ehn, we now have fields such as user-experience design, co-design, design for social innovation and participatory design (Norman 1988; Moggridge 2006; Ehn 1988). This has led to a slow but steady shift in how the design of things, environments and services are understood and realised. Importantly, the outcome of a design process is rarely the end, as users adapt or adopt new applications as their needs evolve.

Our approach to this research thus builds on this discourse and also reflects Ingold's question of how designers might 'design *for* improvisation' (Ingold 2012, 32). To achieve this, sensory ethnography uses the actual everyday environment experienced as part of the research process, inviting participants to use objects and sensory affordances as memory devices or as props through which to share with the researcher activities and experiences which might not normally be expressed verbally, and would therefore usually go unnoticed and un-researched. A sensory ethnography approach also understands knowledge or ways of knowing as emergent from specific configurations of things, processes and persons, that is not predetermined (Pink 2015). As we show in the discussion below, this principle is applied both to our understanding of how staff and patients come to know things, and to how we as ethnographers encounter ways of knowing during research. As we will discuss, the insights generated through such an approach have enabled us to go beyond simply *understanding* what happens in sensory rooms. Instead they also indicate that everyday improvisation/innovation developed by patients and staff, should play an important role in informing future sensory room design.

# Sensory modulation at Bendigo Health

In August 2013, Bendigo Health (BH) initiated a full-time Reducing Restrictive Interventions (RRI) staff position to review the provision of safe environments and alternative options for the care of patients other than those that require restrictive practice. In connection with this role, BH received funding to help implement sensory modulation within the psychiatric unit and used it to develop the first 'sensory modulation room' at BH within the aged psychiatric unit. At the same time, trolleys containing sensory modulation equipment were introduced to the adult acute and secure extended care units. These trolleys ensured that those units without available space could still utilize sensory modulation to try to reduce restrictive interventions, assist individuals to self regulate, and encourage a community of safety. As the program demonstrated its success in reducing restrictive interventions, the adult acute unit also added a sensory room, conveniently positioned for access from both the high dependency and the low dependency units. It quickly became evident that these sensory modulation rooms were achieving the safer environments, alternative care options and reduction in restrictive interventions for patients. As a result, BH committed to the continued practice of sensory modulation, allocating seven rooms within the psychiatric unit of the new hospital for this purpose.<sup>1</sup>

Against this background, and at the time of the study, there were three psychiatric wards at Bendigo Health, all with different patient profiles. The largest was the adult acute ward, with 24 beds, and patient admissions times that average about ten days. The secure extended care unit (SECU) had eight beds, with much longer admission times, sometimes many months or even years. The SECU was not a forensic facility, but provided long-term inpatient treatment and rehabilitation for patients with unremitting and severe symptoms of mental illness, together with associated significant disturbance, that inhibit their capacity to live in the community. The aged-care unit was a mix of 10 older persons acute psychiatric beds co-located with 10 dementia assessment beds, with this patient group under the separate care of geriatricians. All three sites had dedicated Occupational Therapists (OTs) who worked with patients to identify their sensory preferences and what might offer the most therapeutic benefit.

In this section we show how these rooms were configured and encountered through processes of learning and improvisation, in which their experiential affordances were always emergent, rather than predetermined outcomes or wholly predictable. They were also often not easily communicated verbally, and therefore the sensory engagements of both staff and researcher were essential elements of the generation of ways of knowing, understanding and intervening. We present this through the example of Shanti's work with David, an OT who worked extensively with patients both in and by means of the room in the adult acute unit.

In mid-2016, this dedicated space had been set up with rocking chairs, tactile panels on the walls, calming murals and various equipment - things to touch look at, fiddle with, smell or listen to - to help patients modulate their

<sup>1</sup> Findings of the reduction in restrictive interventions at BH were presented in 2015 at 16th International Mental Health Conference, ACMHN's 41st International Mental Health Nursing Conference, 7th Australian Rural and Remote Mental Health Symposium.



mental state. The room sought to obtain three main effects: to calm patients who were upset or agitated; to raise alertness in depressed or disinterested patients; and to distract patients who might be experiencing auditory or visual hallucinations. This room, as well as a similar one in the older persons' unit, had only been introduced about 18 months before the study, and had been repurposed from storage or unused space.

Using the materiality of the room itself as a prompt in the sensory ethnography research encounter, OT David was able to recall and explain the processes and feelings related to it, as he discussed with Shanti (the researcher who was interviewing him) how he engaged with patients in the room. When introducing patients to the room, for example, he explained how he would begin by showing them how to raise or dim the lights, how he demonstrated the rocking motions of the chairs and pointed out the prominent mural of a riverside scene on the wall. These performances of sensory related actions and movement helped patients understand the affordances of the space, what kinds of experiences they might have in it and the control they could exercise in crafting these experiences. Thus the physical aspects of the room itself - the light switch, the mural and the quiet privacy the room afforded - were all part of how patients began to identify ways to help themselves feel better. An example was the river scene mural (Figure 1). David described this as 'just a really good picture of a relaxing calm space. I can relate to this picture because I like being at the river and just chilling out, so I know a lot of our clients like this one as well.' He knew the patients liked this image because they explicitly told him: 'some say ...it's just a really calming place, so as kids they might have gone to the river...and remember either fishing or hanging out with family or friends, and it sort of brings them away from the ward environment and takes them somewhere else, which is really good.'

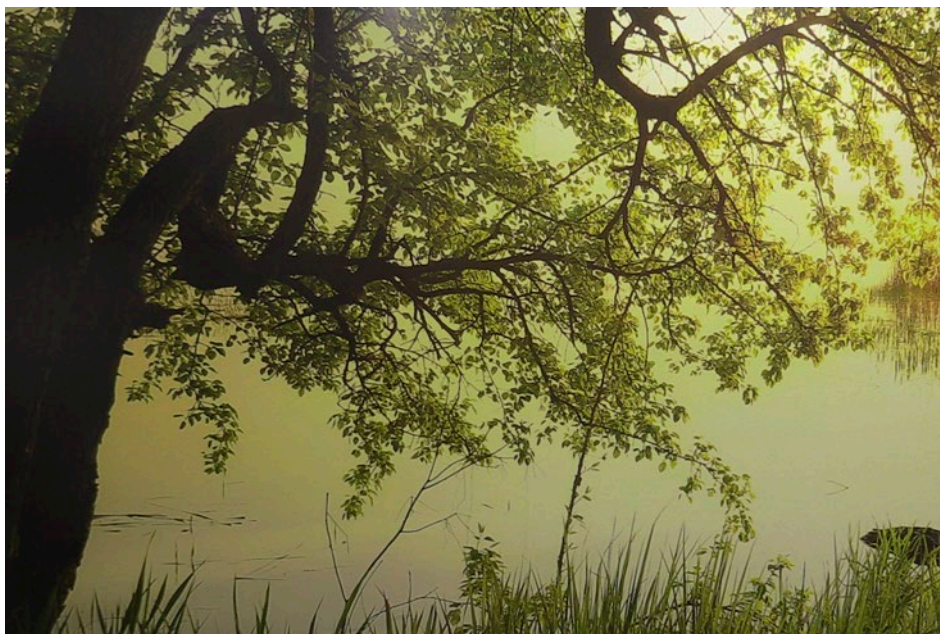


Figure 1. A river scene mural in the adult acute ward sensory room.

While these materialities, light, visual and movement-based experiences constituted key elements of how sensory rooms could be experienced as an environment that people could enter into and be part of, they also contained objects that patients could use in the rooms, or sometimes take back to their own rooms. As David explained, the process of discovering which objects were helpful was often a process of trial and error:

Some patients know what their sensory preferences are. A lot don't know what they like until we come in here [the sensory room] and just try it. So if

they're having trouble identifying what their sensory preferences are...we'll come in here and just try different things and they'll either say yes I do like this or no, it's making me more agitated or angry...We do talk about calming sensations and alerting sensations...someone that might be really depressed might use some sensory equipment to become more alert, whereas others that might be really angry or agitated or needing distraction from voices or anything like that might use sensory equipment to either calm them down or distract them from voices or hallucinations or something like that.

David described how he had to discover how to apply the equipment in the rooms to the particular symptoms of the patients in dialogue with them. These included when they themselves are not able to accurately understand their effects: for example, he pointed out that a patient 'might say this is really calming but we can see that it might actually be alerting.' In these cases, the therapeutic benefit emerged by being in the room and working through the different choices of equipment. It was not a straightforward case of patients having foreknowledge of what they liked or what affordances different objects might have before they encountered them. That is, it was only by working *with* the OT and handling, smelling, looking at or playing with the objects that knowing about what would work could emerge.

David's role also included his reflections on his own preferences, for instance his liking for the river scene mural, his pleasure in handling his favourite sensory objects when showing them to Shanti, and his applications of these experiences in his work with patients (Figure 2). This implied the empathetic relationality of the encounter between David, the patient, the room and the object, with David's insights into what made him feel calm helping him to understand the possible affordances of the various interventions. Similarly Shanti's experimental donning of the weighted cape and blanket quickly taught her that she did not like the sensation they created, but the experience helped her engage with research participants because it enabled a correspondence between her own experience and theirs, allowing her to imagine how they might feel the blanket. In this way, David and Shanti's preferences became part of how they both understood, and in David's case, helped patients come to understand the room and the sensory equipment.

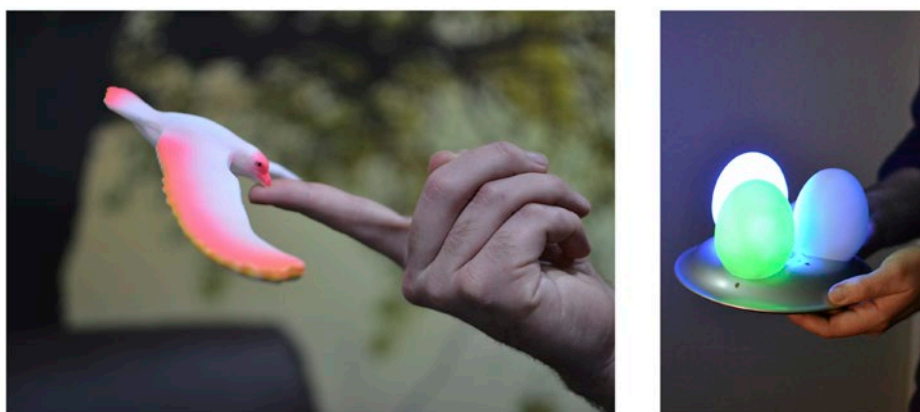


Figure 2. Two of David's favourite sensory objects, a balancing bird and 'magic' eggs that slowly changed colour.

A key theme that emerged in our research into how both staff and patients encountered the sensory rooms was improvisation, as they chose and combined different material and sensory elements. This, David said, involved 'trial and error' as he worked to introduce the different sensory elements to patients and invited them to investigate how they felt. B, a patient in the adult acute ward, conveyed a sense of the improvisation required when she de-

scribed to Shanti how she came to enjoy the sensation of wearing a weighted blanket as a form of comfort.

B: There's two weighted blankets, this one you sort of can wear like a bib and it feels like you're being hugged...you put this around your neck and it's quite comforting.

S: Do you like the feel of the weight?

B: Yeah, it's interesting, like I didn't think I would but it's actually quite nice.

S: How did you figure out that you liked the feel of that, did someone suggest it to you?

B: Yeah, the nurses said well that's what we've got you can give it a go, yeah, I'd never even heard of it before I came in here, um, but I just quite like sitting here in that one and in that one as well [pointing to the chair] it rocks. It's quite nice just sitting.

B went on to explain how she had arrived at a comforting combination of wearing two weighted blankets over her shoulders and lap, rocking in the chair, looking at the mural and smelling a specific fragrance supplied by the nurses. Sometimes she used a toy drawing tablet to repetitively colour in and erase, keeping her hands busy (Figure 3). Over time she had worked out this combination of things, and would return to the room regularly, sometimes after a break of several days, for this experience.



Figure 3. B's favourite rocking chair with the weighted shoulder cape and the drawing tablet she enjoyed colouring in.

In these accounts, the material aspects of the rooms offered a range of potential experiences that only emerged as patients and staff discussed, experimented and trialled different sensory experiences in different configurations. Both David and B's comments emphasised the emergent nature of their knowing about what worked to help patients 'feel better', explaining this as a temporal process that required a willingness to generate unknown new experiences, including staff getting to know their own preferences as a way to understand the different objects' affordances. This could be altered or refined, for example as a patient's symptoms changed, or as their choices were guided by the staff based on their observation of the effect of different sensory interventions. The use of sensory ethnography in this instance helped to demonstrate how knowledge about the affordances of the space and objects of the sensory rooms was improvised and emergent. It also helped unpack how the sensory rooms in the new site were being anticipated and planned, as we discuss next.

# Imagining and planning for the new site

Imagination, like the improvisatory activities discussed above, can also be seen as emergent from specific configurations of things and processes. As anthropologists Sneath et al argue, imaginings 'cannot be fully conditioned' and imagination is therefore 'an essentially underdetermined effect of the conditions that bring it about' (Sneath, Holbraad and Pedersen 2009, 24, 26). As such we understand imagination not as something that is a projection of what is 'far' and what can be predetermined, but rather as an ongoing outcome of what is already happening. Yet simultaneously, the ways we imagine can impact on what will happen in as yet unknown futures. Therefore, the study of how people imagine is important for understanding how we might inform useful co-design interventions into what may happen.

We conducted this study just as the Psychiatric Services Unit was about to move into the new hospital building in early 2017. Many significant changes were anticipated as a result of this move, and staff were planning for the new site and transition to it, including through a careful process of adapting their Model of Care to the new surroundings. Along with many other changes to the hospital built environment, the new site was provided with seven sensory rooms, funding to stock them, and this allowed scope to imagine how they might be used to offer a wider range of sensory experiences. As Shanti interviewed the staff involved in planning for the new site, it became clear that they were trying to anticipate the new built environment, along with how they would use it and what equipment would best meet the wide range of patient needs. The move also presented an opportunity to more deeply embed sensory intervention into the Model of Care, which meant making the techniques, equipment and rooms more accessible to clinical staff and patients alike. For example, in thinking about the new hospital site, David explained how he imagined the rooms in terms of both the variety of their use and the staff who might use them:

*We've purchased a lot of equipment to fill those rooms evenly so we'll be able to do more sensory modulation intervention. Hopefully there will be more staff on board with the sensory intervention stuff, hopefully we're getting more staff to start with, so people can be doing more sensory interventions at the same time, or group interventions if able, if the rooms are big...if it's really big it would be good for groups, but individualised use, I'm not sure. I have to trial it with someone and see what they thought. It might feel a bit empty. Hopefully we've got enough equipment to fill it, but then again we don't want to overload it, so...we'll have to work it out once we get there, I think it will be trial and error.*

Here the anticipated affordances of the rooms - their size, how many people could comfortably use them, how the equipment would be stored and used within them - was unknown. Indeed his ways of imagining the future rooms were not even always possible to verbalise directly, but rather involved a sense of how they could feel; David had an implicit sense of what would 'feel right' in the rooms, expressed as not wanting them to feel too crowded or empty or what would be the best way to organise furniture and equipment in them. This balance, he suggested, could only be reached through experimenting and improvising in the space, trialling it and making changes as necessary.

Another tangible example of this process of imagined improvisation was the purchase of equipment. Lisa, who was responsible for Reducing Restrictive Interventions, led the planning and stocking of the rooms, and helped develop the best ways of using sensory intervention with psychiatric patients across the Unit. As explained above, her role was part of a wider strategy to decrease the use of 'restrictive intervention', and sensory intervention was seen as a key means to help patients calm or distract themselves when agitated. She described how she would like sensory intervention to work in the new facility:

*We've got seven sensory rooms now, so we're trying to equip with as much diversity around things as we can...hopefully we'll be able to have other visual cues that people might like, or sounds that people might like ...we're trying to have a broad enough range, your sights, smells, sounds, all those sorts of things in the sensory rooms, we've also got trolleys, so hopefully someone might be able to take that to their own private space....[we're] talking about calm down boxes so just a box of stuff...dotting it all around the place...so each day might be different for that person...In the box we'll have things like music choices...looking at different things that appeal to different people...you've got your soft-touch things, you've got your weighted [blankets] you've got your heating packs, hopefully we've covered everything...*

By imagining how patients will use the sensory equipment as a product of trial and error that might change by the day, Lisa had tried to select things that could be chosen from, rather than prescriptively designing for particular sensory outcomes. She wanted to allow for as much flexibility and individual choice as she could, and importantly, this included the use of trolleys of individualised boxes so that patients were not restricted to only using the rooms. They could, for example, have music to listen to or a squishy stress ball to play with in their own private spaces, making their bedrooms into a version of sensory rooms. In attending to the mobile possibilities of the techniques, staff were thus thinking about how to allow for new forms of engagement to emerge, but also how sensory interventions could move beyond the confines of a purpose-designed room and instead accompany the patient into many of their spaces. Indeed, this might even reach outside the hospital building, as patients were assisted to buy particular items, such as weighted blankets, that they could use when they were discharged.

A further demonstration of this occurred when Shanti accompanied staff on a trip to buy equipment for patients to use, when it became clear how staff understood the objects in terms of patients' anticipated abilities and desires. For example, Lisa explained 'we're making these decisions based on, partly, safety...so you don't want to get something that's got too many tiny little balls and things, and partly because if a piece goes missing from a game, you've lost the whole game...we're looking at things that can be used as whole group activities but also individual as well.' On a previous shopping trip, she and a colleague had discussed the best items to buy, and so were able to make decisions quickly as they imagined how patients would use the items, what would be the easiest and most satisfying games, any safety risks they posed, and how much time different activities might take. As they moved through the large toy section of a local shop, they quickly filled their shopping trolleys, continually assessing, discussing and imagining the items' affordances and effects.

# Conclusions

In this paper we have initiated a new discussion of the increasing use of sensory rooms in psychiatric inpatient units with reference to the ways that staff and patients participate in their making and design and how they imagine future sensory rooms. As we have demonstrated, the ways that both staff and patients generate ways of knowing about sensory rooms, their affordances and possibilities are emergent, experiential and personal. In the example we have discussed, they involved forms of improvisation and empathetic modes of anticipation, combined with safety and clinical knowledge on the part of staff.

Likewise, when patients became involved with staff in the co-design of their own sensory encounters with the rooms and their materialities, improvisatory and embodied modes of knowing, evaluating and (re)constituting experience were evident. The best outcomes in terms of 'feeling better' emerged from the relationship amongst the patients, nursing or allied health staff, the built environment and the sensory things that were touched, smelled, looked at or felt in the bodies of the patients and staff. This included a process of trial and error and improvisation which enabled staff and patients to come to know what felt best for each individual. When we examined how future sensory rooms were anticipated and imagined, we saw that staff engaged with these by similarly acknowledging the emergent qualities of their encounters with these spaces. They imagined each patient as different, with different configurations of things and processes appropriate for each patient to co-design with staff the specific ways that the sensory and material affordances of such rooms could be engaged towards generating forms of wellbeing.

Accordingly, we have taken a design anthropology approach to interpreting this context. Rather than identifying a problem to be solved by design, we have sought to understand how sensory rooms are already designed by 'everyday designers' - staff and patients applying their own formal and informal knowledge and experience to improvisatory modes of everyday action. Having demonstrated these existing examples of good practice, and the underpinning understandings that inform them, we now raise a further design question: how might design research and intervention play a useful role in acknowledging and providing frameworks for the development of such processes, engaging with how patient and staff practices and imaginaries might best be understood and accounted for in future.

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# Injury Prevention in Institutional Settings in Sweden

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## ABSTRACT

*This paper analyses injury events in different Swedish welfare settings, with an aim to highlight prevention potentials and applicable strategies in the institutional settings. Previous research has mainly focused on preventing strategies related to primary or individual level, but this study instead examine the possibilities of injury prevention or injury reduction by modifications of the physical environment, so called situational prevention. The preventive approach in the study is related to previous work in the field of crime prevention and health promotion through environmental design. These welfare institutions are designed to shelter vulnerable individuals, but they are the second most frequent injury place according to previous research. We used an extract from Injury Data Base, containing information from all emergency rooms visits in four Swedish municipalities from the year 2013. We conducted both within- and cross-case analyses, in order to explore the situational elements of the events. In general, the results show that the majority of injury events involve individuals that are above 80 years old, and the most common injury type is fall related injuries. Moreover, the injury pattern interrelates with activity. Conform activity, defined as day-to-day activity, related to unintentional injuries, such as tumbling, tripping and falling. These situations mainly occurred in institutions such as nursing homes, retirement homes and accommodation for individuals with disabilities. The non-conform activity, such as creating opportunity for self-harm acts, were more frequent in closed institutions such as psychiatric wards, youth accommodations or prisons. These findings implicate that two different prevention strategies are suitable. The first aiming at reducing the risks connected to mobility by reducing uneven floor surface, place rails on the wall or install impact-absorbing floors. The second strategy aims to design a physical environment that facilitates a higher degree of surveillance inside the institution.*

**Keywords:** Injury events, total institution, situational prevention, injury prevention, physical environment

## Introduction

The aim of the ArcSafe research project, based in Gothenburg, Sweden, is to achieve more knowledge about injury events in residential environments in order to improve injury prevention and safety promotion efforts in this setting. The research is trans-disciplinary organized and the members of the research group come from different university departments in architecture, sociology, public health and social work.

This paper addresses injury events in different welfare- and healthcare institutions in Sweden, here called 'total institutions'. Our understanding of total institutions is derived from Goffman's definition: total institution is a place of both work and residence, with a large amount of similarly situated individuals (1968/1991). Moreover, as Douglas states, institutions also rely on a hierarchical classifications of needs (Douglas, 1986).

Approximately 9 % of the Swedish population is living in different residential institutions, such as nursing homes or other accommodations for individuals needing daily care (SCB, 2014). Mainly, these welfare institutions are home- and living environments for those who should be protected in society, for example elderly or individuals with various disabilities. The living environments are therefore, in general, modified or adapted for individuals with special needs. Based on this, it seems reasonable to assume that it would be a safer environment compared to an ordinary home, especially when it comes to injury events. But is this the case?

Research suggests that this is not always the case. A recent study, conducted by Ekbrand et al. (2016), found that the institution is the second most common place for fatal injury events in Sweden; 402 individuals died in injury events that occurred in the private home and 207 persons died in injury events in a public institution. In comparison only 163 persons died in traffic incidents. These statistics indicate that institutions represent paradoxical conditions. On one hand they shelter risk groups for both indoor- and outdoor environment. On the other hand, these groups have a limited ability to take responsibility for their own safety in institutional settings, mainly when it comes to risk exposure (cf. Swedish Civil Contingencies Agency, 2014; 2015). Therefore, injury risks and injury events need to be explored further. In addition, one reason why it still is of interest to study institutions is the fact that housing-conditions in institutions, for example layouts and sizes, are much more homogenous than the conditions in ordinary housing.

Previous studies of the institution as an arena for injury events, have mainly focused on fall-injuries concerning elderly or individuals with disabilities (Linattinemi et al. 2009; Nilson 2014; Wang et al, 2009; 2011), injuries in youth accommodations, psychiatric wards (Wästerfors, 2012) or violence in prisons (Wästerfors, 2007). In these studies the focus has been on individual predisposition for injuries, such as age, gender or personal traits, and not so much on the interaction between the individual, the environment and the etiological factors (cf. Garzon, 2005). But at the same time, there is evidence that the environment is an external risk factor for injuries (cf. Keall et al., 2015; Mack et al., 2015).

In contrast to previous research, this paper will concentrate on situational elements in injury events instead of focusing on individual factors. These situational elements are defined as place, type of injury and activity. Later in the presentation these will be related to prevention, so called 'situational prevention', which is defined as all measures aiming to prevent physical and social factors influencing the situation in a harmful way. The concept of situational prevention is adapted from Cornish and Clarke (2003), who discuss situational crime prevention as a technique based on situational

analysis, by identifying clusters of events in time or place (cf. Wortley, 2008). Almost the same concept is applied in the Haddon Matrix for injury prevention. In the matrix three levels of prevention is optional pre event, during the event and post event, all levels differenced in agents, as individual, social and physical environment and etiological factors (Haddon, 1973; 1980). Other related concepts based on situational prevention are: crime prevention through environmental design (CPTED) and health promotion through environmental design (HPTED) (Lab, 2007; Cozen & Love, 2015; Kent & Wheeler, 2015).

The purpose of this paper is to highlight prevention potentials and strategies in different settings, with main focus on the interaction between the individual and the environment. Since institutions are regulated by policies regarding safety and security, we assume that the implementation of preventive measures is easier to carry through in the institutional setting compared to the private residential setting. The study will be conducted in three steps, guided by three research questions:

1. What situational elements are traceable in injury events occurring in institutional settings?
2. What patterns of socio-spatial connections can we find by mapping the relation between injury events, situational elements and type of institution?
3. How can these findings be related to prevention strategies?

#### *The Swedish regulations*

Sweden has a specific law system regulating institutions, as well as different support systems and coercive measures. The Social Services Act [SoL] regulates the most common forms of support, such as personal assistance, home care and nursing homes. Housing with special service, such as 24/7 assistance, is regulated in the Act concerning Support and Service for Persons with Certain Functional Impairments [LSS]. The aim of LSS is to ensure that people with severe and permanent disabilities have good living conditions. Decisions concerning children and youth in need of special accommodations due to either deviant behaviour or living in a destructive environment, are regulated by the Care of Young Persons Act [LVU]. Individuals over the age of 18 and with an on-going addiction problem can sometimes be incapacitated due to the Care of Abusers Act [LVM]. Individuals with acute psychiatric difficulties can be incapacitated due to the Compulsory Mental Care Act [LPT]. The regulation of rehabilitation and incapacitation for illegal deviance can be found in the Swedish Penal Code [BrB], and the prison system is based on a rehabilitation ideal aiming at reintegration in society.

#### *Three types of institutions*

In Goffman's work 'Asylum' (1968/1991) the total institution is characterised as a 'closed world' in relation to the wider community. The main focus is on processes of 'institutionalization' (Goffman, 1968/1991:4 ff.; 94; 189). That is how patients adapt to social roles, behaviour and functions ascribed by people working for the institution. Total institutions share three attributes:

- 1) The institution is a social hybrid combining residence and work, divided only by individual social roles and the symbolic rituals connected to these.
- 2) The hierarchy of the institution enforces certain rules of performance resulting in 'expected' behaviour by staff and patients.
- 3) The everyday at the institution is sequenced into different phases resulting in a formal administration of life (Goffman, 1968/1991:5).

Goffman describes five different types of institutions: those established to take care of the harmless and incapable of society (e.g. nursing homes or orphanages), those established to take care of individuals incapable to take care of themselves temporarily or permanent (e.g. mental hospitals or sanatoriums), institutions organised to protect society from intentional danger (prisons or concentration camps), institutions aiming to create opportunity for retreat from the world, often with religious purposes (e.g. convents or abbeys) and, finally, institutions based on instrumental grounds like work camps or boarding schools (cf. Goffman, 1968/1991: 5; 118).

Following this, we have identified three types of institutions operating in the context of Swedish health and custodial care. The first one aims at taking care of individuals (e.g. somatic hospital wards, retirement homes and accommodation for individuals with disabilities)<sup>1</sup>. The second type of institution aims at taking care of individuals who are a risk to themselves (e.g. psychiatric wards and closed accommodation for individuals with addictions problems, conduct disorders or deviant behaviour)<sup>2</sup>. The third type of institution is the one designed for individuals seen as a danger to society (e.g. prisons and similar accommodations)<sup>3</sup>. All these institutions share the three common attributes, stated by Goffman, but differ regarding to what extent they can be seen as 'total' (see figure 1).

[figure 1 inserted here]

#### *Institutions aiming at taking care*

In Sweden there are three kinds of housing regulated by SoL or LSS: group homes, sheltered housing and other specially adapted housing. The group home is offered to a person who is in extensive need of supervision and care, a need for professional support around the clock. In group homes there are a small number of apartments combined with common areas for the residents. Service homes consist of apartments with common service that are tailored to individual needs. Also here, the individual has support around the clock. The third housing type is specially adapted housing. This means that the apartment is tailored to individual needs, but there is no regular staff at the place.

Only 5 % of the people over 65 years in Sweden live in institutions, such as nursing-homes (SKL, 2009). The remaining 95 % live either in their own home, in apartments in multifamily-buildings or in one-family houses. This is the policy of the Swedish government – the first alternative should always be to stay in the ordinary home as long as possible when one grows old, if needed, with help from the home-services. (SOU, 2003) However, before we discuss this predicament, we would like to distinguish between two categories of elderly, namely the young-old and the old-old, or people in the third or fourth age (Simpson, 2014). Most persons in the third age, 65-85 years, usually don't have any serious problems with their ordinary apartment. But in the fourth age many elderly have physical ailments and they feel unsecure and isolated. At this stage, many would prefer to move to a nursing home. There are, however, too few positions and one has to be in a very bad condition to be offered a position.

The opportunities for housing and housing support concerning individuals with different forms of disabilities, impairments or chronic illness, have gone through major changes under a number of years in Sweden (cf. Skårner, 2012; Brolin, 2016). The health care system has changed and there has

<sup>1</sup> In a Swedish context: LSS-boende.

<sup>2</sup> In a Swedish context: LVU- and LVM-boende.

<sup>3</sup> In a Swedish context: §12-boenden for example.

been a shift from institutional treatment in large units to a more community-based care. This means that the individual has an own home or lives in smaller accommodation units with personally designed support. In recent years, research has been conducted focusing on subjective experiences of residential and institutional settings. For example studies of the housing situation of people with mental disabilities have pointed at the importance of individual choice concerning the residence and also the significance of balancing feelings of privacy and safety (Buys et al. 2008; Berlin Hallrup; 2012; Kåhlin, 2015; Brodin, 2016:5).

#### *Institutions aiming at individuals at risk or who is a danger to society*

Research regarding psychiatric wards, prisons and rehabilitation accommodations for individuals with either addictions or need of psychiatric care has focused the social aspect, which is the need to develop supportive environments and facilitate the care situation in such institutions (Brunt & Rask, 2005; Wästerfors, 2007; 2012). Studies show that the interplay between environmental, social and individual factors is central to understand what issues that can develop in a capsuled environment where individuals have no freedom or authority when it comes to the daily life.

## Material and method

To map and analyse situational elements in injury events we combine descriptive statistics with a qualitative content analysis (cf. Cresswell, 2014). The directed qualitative content analysis is aiming to analyse explicit situational elements stated in the data (cf. Krippendorff, 1980). The main reason for using a mixed method approach is that (descriptive) statistics only report the distribution and frequencies of injury events and not the situations in which they occurred.

In our ongoing project, ArcSafe, we have access to three different medical records, and for this study an extract from Injury Data Base (IDB), covering the year 2013, has been used. IDB contains variables related to age, gender, time and injury type. Moreover, IDB also register the place of occurrence and have a small self-reported narrative describing the injury event (for a more thorough description of the IDB-variables and register process see: Gyllencreutz, 2015; Thodelius, 2016). However, IDB is not a national health care register, and our extraction only contains injuries treated at the emergency receptions (ER) at certain Swedish regions: the regions of Skaraborg, Värmland, Umeå and Uppsala (approximately 7% of the Swedish population). We also have a limited scope then it comes to the two institutions defined as 'taking care of individuals who are a risk for themselves' and 'individuals that are a danger to society', due to the geographical distribution. To address the limitation in the geographical distribution, the result needs to be understood as transferable and not generalizable (Lincon & Guba, 2000).

Cases have been selected by combining two search-strings in the register: place of occurrence ('institution' is default in the variable list) and the free-text form. In the free-text form search was conducted using the following keywords: [Group\*], [Psych\*], [Service\*], [\*Care], [Clinic], [LSS], [LVM], [LVU], [\*Home], [Youth\*], [\*Institution], [\*Accommodation\*], [Asylum], [Prison] and [\*Residents]. This search resulted in a total of 240 cases for the statistical analysis (N<sub>1</sub>). For the qualitative analysis, the free-text forms for all cases were read through and cases with scarce information about the event were excluded (e.g. 'one-liners' like 'person X fell'). A total of 218 cases remained after the exclusion (N<sub>2</sub>).

The analysis was conducted in two steps: first a within-case analysis and second a cross-case analysis. The first analysis was inspired by the multisite study (Schoefield, 2000) and performed by dividing the total  $N_{1,2}$  into smaller sub categories (e.g. facilities such as nursing home). Every sub category was then analysed using pattern matching to isolate situational factors (Yin, 2014). In the second step, cross case analysis, the sub-categories were clustered into categories (e.g. institutions defined as 'take care', 'at risk', and 'danger to society'). At this stage the similarities and differences between the patterns were compared and examined by applying Mills joint method of agreement and difference (Ducheyne, 2008).

In the study we have followed the ethical principles discussed by Beauchamp and Childress (2013). The research project has been approved by the Regional Ethical Review Board in Gothenburg (registration number 464-14).

## Result

As can be seen in figure 2, a majority of the injury events involve individuals more than 80 years old. This outcome is incident to a relative high median age in the data set (76 years, std. dev. 21.5). Furthermore a gender difference related to age emerges; the majority of injuries involving females occur in the oldest age group (two out of three). For men, approximately half of the injuries occur in the institutional setting for the oldest age group. On the other hand men have more injury events in all other age groups. The gender difference for the two oldest age groups can be explained by two different factors biasing the data set. Firstly, females live longer compared to men, which influences the injury distribution in the oldest age group, since there are in fact more females than males in the nursing homes. Secondly, the statistics are based on emergency rooms visits, and since females have a biological disadvantage in terms of incurring osteoporosis after the age of 50, they tend to suffer more severe injuries compared to men. In addition, our results seem to be in line with previous research which also has showed that females over 65 have the highest risk to get injured and that they have a greater risk compared to men getting injured indoors (NCO, 2005). Probably this is the reason why the complete data set has a general uneven gender distribution (33.5% of the injured were males compared to 66.5% females).

Likewise, the data set only includes injuries treated at the ER, and institutions have different opportunities to treat minor injuries in the setting. Probably, only the most severe injuries from hospital wards and nursing homes are remitted to the ER, which differentiate these institutions in relation to other settings. Also, the geographical distribution biases the sample when it comes to the 'at risk institution' and 'danger to society institutions', since we only can examine male prisons and a few youth care accommodations, resulting in a low n. Despite this, we believe that we can identify the sequence of events leading to injury events, the aim being to ensure situational elements and not to quantify the extent or frequency.

[Figure 2 inserted here]

### *Injuries and injuries event in the different institutions*

Injury events in the 'take care' institution are dominated by elderly's injuries (distribution of injuries are shown in table 1). Out of 169 people in the material, 149 lived in an institution, that is, some form of assisted living or nursing home, while the other 19 people mainly lived in short-term and/or service housing. Almost all events were fall injuries; only 10 injuries were due to other causes, three of those were about violent interplay with a fellow

patient. For the vast majority - about 96% of the loss events thus took place either in their room or in a common room at the institution.

Accommodations for individuals with disabilities also have more unintentional injuries than intentional injuries. In more than half of the cases, the injuries were a result of fall incidents. The individuals have tripped or fell down on the floor. In research literature people's use of different aid facilities is a risk factor, such as falling out of wheelchairs (Xiang et al., 2006; Wang, 2011), but in our sample this incident was only present in six cases. In three cases the injury event was a result of an aggressive action, such as anger, confrontation or as a side effect of medication. In the somatic hospital wards, the injury events are mainly occurring during situations of activity (going up from bed, getting dressed and so on). It seems to be a combination of mobility, medication and illness resulting in an injury event; the sample also consists of persons with a fairly high age. The somatic hospital wards have a low number of injured individuals, which probably is due to minor injuries being treated in the ward and only major injuries are remitted to the ER.

[Table inserted here]

In the 'at risk' institutions, including psychiatric wards at hospitals or accommodations for individuals with deviant behavior or addictions problem, the injury types shift from unintentional to intentional injuries. The injured persons are also younger compared to the 'take care' institutions. At the psychiatric wards, only two cases of nine were related to medical conditions. The others were related to self-harm either by cutting or poisoning. In accommodations for individuals with addiction problems, both intoxications after being on parole and self-harm acts were the most common injuries. In the last type of institutions, including the most total one ('danger to society' institutions), we find the youngest persons in the sample, mean age 24 years. Only two of seven cases in this context were related to medical conditions. The rest was different intentional injuries, mainly self-harm or intoxications. Interestingly, we can see a gender difference, both related to injury type and institutions. All male cases were from prisons, where the injuries were both intentional and unintentional, while all female cases were from institutions for youth with deviant behavior and all of them related to different acts of self-harm. This relation can be due to the geographical distribution of the data related to prisons, since there only are male prisons in the geographic area. But, the geographical distribution of the dataset cannot explain the gender homogeneity in youth institutions.

#### *Cross-case analysis*

In table 2 the results from the within-analysis is summarized and traceable situational elements defined; this table is also the basis for the cross-case analysis. In the cross case analysis, the institutional setting of the different injury patterns becomes clear. The most significant difference is between the unintentional fall-injuries at the 'take care' institutions and the intentional injuries that dominate the two other institutions. One of the institutions, the prison, has a different injury pattern with bigger variation compared to the other closed accommodations. This is probably due to the special form of healthcare and rehabilitation prevalent in the prison setting. The day-to-day activities in a prison are more similar to a regular out of institution everyday life, compared to the other healthcare institutions. In prisons routines are regulated: since the inmates are awakened, have breakfast at a certain time, go to work/school/rehabilitation and have some spare time<sup>4</sup>. This structure

<sup>4</sup> Källa: Kriminalvården: En dag på fängelset [The Swedish Prison and Probation Service: A day at the prison]: <https://www.kriminalvarden.se/fangelse-frivard-och-hakte/fangelse/en-dag-pa-fangelset/> [read online 170308].

allows a more broad exposure to different settings and therefore a more varied injury pattern.

[Table 2 inserted here]

Injury events seem to be related to different variables interrelated with activity (see table 2). The activity is further related to aspects of conditions making the activity possible (situational elements in the injury). For example, in a somatic hospital the ability to move can be lowered due to the medical condition (illness and/or medication), and an activity (as going up from bed) that is easily managed at home during 'normal circumstances' can at the hospital result in a fall. The relation between activity and injuries can in the analysis be divided into conform and non-conform activities resulting in unintentional or intentional injuries. Conform activities are defined as social expected behavior, or behavior responding to the societal norms. The non-conform behavior on the other hand, has an intention of being rule or norm breaking. In the first case, the conform activity results in unintentional injuries, mainly falling, due to hindrance of mobility – these elements can be understood on an individual level as somatic problems, medication, misjudgment of ability due to being tired or stressed. In the second case, the non-conform activity and the intentional injury, the main variable is the lack of surveillance, which create an opportunity for certain acts. The similarity between the institutions is that the injuries in a majority of the cases occurred when the injured person was alone in a private or semi-private room at the institution.

## Discussion

Similar to previous research, this study shows that the 'take care institution' is housing the two main risk groups for injury events: the elderly and individuals with disabilities. In addition, the study verifies previous research on injury mechanisms, e.g. fall injuries for these groups (Swedish Civil Contingencies Agency, 2014; Eriksson et al, 2008; Nilson, 2014).

Approximately 400 potential risk factors for fall related injuries have been listed in previous research and in general these are divided into five major categories: environmental, medicational, nutritional, lack of exercise and related to medical conditions and/or changes associated to the ageing process (Masud & Morris 2001; Linattinemi et. al 2009). In this study, we are interested in mapping the connection between social and spatial factors in relation to injury events. The focus has therefore been on the interaction between the individual and the environment and we have found support for the importance of taking this relation into consideration. Mainly, in the 'take care' institutions the environment needs to facilitate the individuals' mobility, and facilitate their day-to-day activities. In contrast, the institution designed for individuals seen as a danger to society, needs to facilitate surveillance of the individuals' day-to-day activities.

### *Strategic situational prevention to reduce injury events*

As mentioned in the beginning of this paper, one of the aims of the Arcsafe project is to suggest preventive means and strategies in order to diminish injury events. In relation to the data analysis, we will therefore discuss possible preventive measures, based on previous research in the injury field. We note that in almost all cases the injuries occurred when the injured was alone in a private or semi-private room in the institution. This indicates the importance of balance between the individuals' privacy and staff attendance in the institutions. In addition, the activity can be divided in conform and non-conform activity resulting in unintentional or intentional injuries. When it



comes to the injury patterns these are different between the three types of institutions.

The institution aiming to take care of individuals (e.g. somatic hospital wards, retirement homes and accommodation for individuals with disabilities) is dominated by unintentional injuries and conform activity. Mainly, fall injuries are due to hindrance of mobility; in these cases the physical environment can be a factor by facilitating mobility or reducing the consequences of injuries. By comparing our result to previous research of extrinsic risk factors and prevention, we found that the main strategies suitable for the 'take care' institutions are: flooring, support balance, lighting and distance/proximity.

For example by reducing the amount of uneven floor surface, thresholds or loose rugs, the risk for tripping or stumbling can be reduced (cf. Bueno-Cavanillas et. al 2000; Ambrose et. al 2013), which is one of the main injury mechanisms in 'take care institutions'. In addition, strategies can also aim to reduce the consequences of fall accidents. For example, to install impact-absorbing flooring in residential care facilities can have a positive effect since it will redistributed the energy of the fall (Ryen & Svensson, 2016).

To facilitate mobility and to reduce risks for balance loss, plugs or rails can be placed on a reachable place on the wall. There is also support in our study that to improve the lighting or to use visual contrasts may help to prevent miscalculations (cf. Nitz et. al 2011; Ambrose et. al 2013). Likewise, the bedroom and the bathroom are the most frequently mentioned spaces in connection to injuries, which indicates the need to work with these specific areas. Reiling presents a list of safety design features aimed at creating safe environment in a patient-room *"(...) proximity between bed and bathroom, with railing support to reduce the potential risk for patient falls."* (Reiling 2006).

In contrast to the conform activities, the non-conform activity takes place at the other two institutions, and is conditioned by the lack of surveillance. Injuries due to self-harm, was mainly found in the two other types of institutions aiming to take care of individuals that are a risk for themselves (e.g. psychiatric wards and closed accommodation for individuals with addictions problems, conduct disorders or deviant behaviour) and the institution designed for individuals seen as a danger to society (e.g. prisons and similar accommodations). The physical environment can here facilitate a higher degree of surveillance and increase the degree of social control, by making the staff circulate naturally in the corridors, and also implement a stress reducing architecture (Ulrich et al., 2012).

Additionally, we want to stress the importance of ethical considerations when situational prevention is applied. The strategy is based on reducing opportunities, with a direct effect on events and an indirect effect on individual's activities. As previous research has shown, there is a distinction between help and too much help. Risky behaviour can be emancipatory, since the ability to take risks can make individuals grow and give meaning to a person's life (Victorian Equal Opportunity & Human Rights Commission, 2014). There is a difference between having control and being controlled. The institutions need to balance privacy with visibility and surveillance, and the degree of control needs to be adjusted to the right level. Further, since society is in constant change, creating new opportunities for injury prevention, but also new risks and risk groups, solutions need to be adaptable. Therefore it is necessary to balance three elements in the applied measure: (re-) production of power, degree of control and permissiveness to societal changes (Das & Teng, 2001; Potter & Randall, 2013).

### Limitations

There are two main limitations of the study. The first is related to the data material. In IDB the specific room (such as kitchen, toilet or bedroom) is not consequently reported. In many cases 'Institution' is stated as the place of occurrence. Secondly, reasonably the institutions have a high number of incidents not reported in IDB. Minor injuries are probably treated in the setting and only the most severe injuries need to be treated at the Emergency Reception (ER). However, when it comes to prevention, we don't think this weaken our conclusions, since if we prevent the worst injuries, we also will capture the minor ones.

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**Table 2:**

Table 2: Summary of result from within-case analysis (N=218)

Institution type	Included facilities	Injury type	Gender/age	Traceable situational elements				
Take care	Somatic hospital wards	Unintentional fall - injuries	Mixed, 70-89 years	Hindrance of mobility	Medication	Somatic problems	Nighttime (bed or toilet)	Tripping/tumbling
	Nursing homes and retirement homes	Unintentional fall-injuries	Female, 64 years or older	Hindrance of mobility	Somatic problems	Nighttime (bed or toilet)	Room (private or semi-private)	Tripping/tumbling
	Accommodation for disabled individuals	Unintentional fall-injuries	Mixed, 20-67 years	Hindrance of mobility	Secondary medical problems or illness	Lack of social control	Tripping	Falling
At risk	Psychiatric hospital wards	Intentional self-harm	Mixed, 20-60 years	Opportunity (lack of surveillance)	Modus related (having access to razors or medication)	Related to coming back from parole	-	-
	Accommodation for rehabilitation and treatment	Intentional injuries, self-harm or intoxications	Male, 20-60 years	Opportunity (lack of surveillance)	Related to going on or coming back from parole	-	-	-
Danger to society	Accommodation for deviant youths	Intentional injuries, self-harm or intoxications	Female, 17-22 years	Opportunity (lack of surveillance)	Modus related (having access to razors or medication)	-	-	-
	Prisons and similar accommodations	Mixed	Male, 19-45 years	Opportunity (lack of surveillance)	Confrontations	Medical conditions	-	-

# Stress Hormones Mediated by The Built Environment; A possibility to influence the progress of Alzheimer's Disease?

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# Abstract

Due to the aging society, dementia is one of the major challenges to the health care systems all over the world. The growing number of patients, the long process and intensive need for care, especially in the later stages of the disease, make the growth in human as well as socioeconomic costs huge. The development of design strategies for nursing homes and other health care facilities such as day care centers addressing the needs of dementia patients is therefore very important. The vast majority of dementia cases is Alzheimer's Disease, representing approximately 70% of all cases. Alzheimer's disease is a neurodegenerative disease that starts in the hippocampus structure in the brain's limbic system. The hippocampus has three interconnected functions; it holds the cognitive map we use for way-finding, it creates new memories and it forms part of the feedback mechanism that controls the stress hormone cortisol. In the early stages of the disease, the impairment of way-finding and memory is particularly evident. These symptoms are therefore most often prioritized in design proposals and guidelines for AD patients. However, in this paper we argue that perhaps the most important impairment to address is the weakening of the hippocampus' function in the stress system, as the lack of control of cortisol levels during stress can lead to further degradation of the hippocampus. We refer to a stress experiment suggesting that is possible through the built environment to influence the release of cortisol during stress. This again suggests that the design of e.g. nursing homes can contribute to a slower development of AD in its early stages.

*Keywords: Stress, cortisol, architecture, Alzheimer's Disease.*

# Introduction

Due to the aging population, dementia is an increasing challenge to the quality of life worldwide. In 2003, it was estimated that there were 27.7 million demented persons worldwide, estimated to increase to 42 million in 2020 and 81 million in 2040. In 2015, dementia became the leading cause of death in England and Wales (Office for National Statistics, 2015). Due to the lack of effective treatment and the lengthy course of care, it is also a substantial economic challenge to society, with an assessed annual cost in 2007 of 300 billion USD worldwide in direct and home care costs combined (Ferri et al. 2005; Wimo et al. 2007; Prince et al. 2013). Alzheimer's Disease (AD) is by far the most common type of dementia, constituting approximately 70% of all cases (Ricci et al. 2012).

AD is an irreversible, terminal neurodegenerating disease. The progress is often described to occur in three stages: (1) Early symptoms including difficulty with language, experiencing problems with short-term memory, being disorientated in time and getting lost in familiar places, showing signs of depression and aggression; (2) In the next stage, the person is very forgetful, becomes totally dependent on care and needs assistance with dressing, personal hygiene, visiting the toilet, bathing and washing. The person wanders and sometimes get lost, shows abnormal behavior such as unprovoked aggression and may experience hallucinations; (3) In the late terminal stage of the disease, the patient will have difficulty eating, will not be able to recognize relatives, friends or familiar objects, and will suffer from bladder and bowel incontinence. Muscle mass may deteriorate to a point where the patient is confined to bed or wheel chair. AD ultimately leads to death, although the cause of death might be an infection and not the disease itself (Cayton et al. 2001, pp. 27-28; Thompson et al. 2004; Gazes et al. 2012).

With the predicted number of AD cases, the human and economic costs involved, as well as the massive demand for care required for AD patients, AD will no doubt be one of the biggest challenges for the health care system in the future. Consequently, the need for nursing homes built for AD patients will grow not only in Denmark, but also worldwide. It therefore becomes crucial for everyone involved in the planning and design process to understand the demands of AD patient care.

At the moment, the cause of AD is not known, although there are competing hypotheses (Cairns 2009; Gazes et al. 2012). These include the possibility that elevated levels of the immune regulatory stress hormone, cortisol might play a role in a complicated interplay with the immune system, due to chronic stress and/or a history of depression (Ricci et al. 2012). Another risk factor is hypothesized to be exposure to cortisol during prolonged stress earlier in life, which is associated with permanent damage to a brain structure called the hippocampus, as the hippocampus is the first part of the brain to be degraded by AD (Jorm, 2001). There is no cure for AD, but it seems possible to slow down the progression of the disease in its initial phases by a combination of medication, mild physical exercise and diet (Bragin et al. 2005).

If the design of care facilities like nursing homes for the aged are to be able to contribute to this delayed progression of AD, a first step must be to understand which physiological mechanisms might be responsible for such an ef-

fect, and then to ask the question whether these mechanisms can be influenced through the design of the physical environment.

## The hippocampus

As mentioned above, the first structure in the brain to be attacked by AD is the structure in the brain's limbic system called the hippocampus. The degradation of the hippocampus includes both loss of hippocampal volume as well as changes in its shape. In the early stages, AD patients have shown hippocampal deformation involving 38% of the hippocampus' surface, progressing in just a half year to 47%. In the later stages of AD, the degradation progresses into frontal and occipital parts of the brain. Throughout the development of the disease, the weight of the brain is typically reduced from the average 1250 – 1400g, to less than 1000g. The progression of the spreading of AD in the brain correlates strongly with the decline in cognitive and other abilities (Thompson et al. 2004; Csermanský et al. 2005).

The function of the hippocampus can largely be divided into three main functions, appearing rather different at first sight: formation of new memories, wayfinding and stress control. The three main functions of the hippocampus were discovered independently of each other, and only later has their interdependence been largely understood. The most common attempts to adapt the design of facilities for AD patients address the impairments caused by the two first of the hippocampal functions, by way-finding strategies, by making e.g. nursing homes 'homely', and by having the patient bring e.g. pieces of furniture they associate with memories etc. (Day et al., 2000). However, in this paper we will argue that while these strategies might ease the symptoms, the only chance that the design of the facilities can contribute to slowing down the development of the disease, is by addressing the third function of the hippocampus, namely its function in the stress system.

## The hippocampus and memory

The 1950's was an era of psychiatric surgery during which the brain was operated on in the hope of curing psychiatric conditions of various kinds. With the purpose of curing severe epilepsy, a patient called H.M. had his hippocampus removed in both sides of the brain. The unexpected outcome was that his memory was reduced so that he was unable to recognize anybody he had not seen within the last minute. H.M. was intensely studied, most prominently by Milner and Scoville. In a study on the case of H.M. and ten other cases of psychiatric surgery in which parts of the limbic system had been removed, they report that: "The findings in these 10 cases point to the importance of the hippocampal region for normal memory function" (Scoville and Milner 1957, p.20).

## The hippocampus and wayfinding

In 1971 experiments with rats having electrodes positioned in the hippocampal complex of their brains led O'Keefe and Dostrovsky to discover that certain neurons in the rats' hippocampus reacted to certain places. This led them to propose that "the hippocampus provides the rest of the brain with a spatial reference map. The activity of cells in such a map would specify the direction in which the rat was pointing, relative to environmental land marks and the occurrence of particular tactile, visual, etc., stimuli whilst facing in that orientation." (O'Keefe and Dostrovsky, 1971). This led to intensive research into the way this cognitive map was represented in the brain (see for

example Shapiro et al. 1997). Although the complicated interaction between spatial navigation and memory in hippocampal function is not yet fully understood, it is by now clear that they are more or less two sides of the same coin (Burgess et al., 2002; Bird and Burgess, 2008).

## The Hippocampus and the stress system

In 1969, Bruce McEwen and colleagues (McEwen et al. 1969) found that several brain structures had receptors for the stress hormone cortisol, and that the brain structure that by far was the most sensitive to cortisol was the hippocampus. To understand the role of this sensitivity of the hippocampus to cortisol, it is necessary to briefly describe the stress system and the role of the stress hormone cortisol.

### The stress systems:

No single generally accepted definition of stress exists. On the contrary, there exists an “almost chaotic disagreement over its definition” (Mason 1975a, p.6), not least due to the widespread and popular use of the notion. This requires any researcher to individually clarify the definition used (Mason 1975b, p.34). A key concept for understanding stress in the physiological sense of the word is the concept of the homeostatic balance, which is a key concept within physiology, first coined by the American physiologist Walter B. Cannon in 1929. Cannon stated that to keep its inner biochemical milieu within the quite narrow limits that allow for the processes of biological life to function, any living organism must be able to counteract the often relatively wildly fluctuating changes in the environment, in which the organism lives.

As such, stress constitutes a necessary adaptive response with the purpose of reestablishing the homeostatic balance and therefore, stress can simply be defined as a state of threatened homeostasis (Chrousos et al. 1988).

In order to protect or reestablish homeostasis, a stress response in general consists of an adaptive behavioral response. To enable such a behavior e.g. the so-called fight-or-flight behavior, a comprehensive redistribution of the body's resources takes place. Behaviors and processes that are energy consuming and not immediately necessary e.g. feeding, digestion, growth, reproductive behavior and immune function, are suppressed. (Johnson 1992). All higher animals including humans possess two major and, to a certain degree, overlapping stress systems. The most immediate stress response is provided by the one part of the autonomous nervous system (ANS), the sympathetic nervous system (SNS) which e.g. in a matter of seconds can increase heart rate and blood pressure and instantly trigger the release of adrenaline. The other part of the ANS, the parasympathetic nervous system (PNS), can terminate the stress reaction even more quickly. The other system, the hypothalamic-pituitary-adrenocortical (HPA) axis works by releasing hormones into the bloodstream. Corticotropine-releasing hormone (CRH) is released from the hypothalamus which, when it reaches the pituitary gland, makes it release the adrenocorticotrophic hormone (ACTH), which in turn makes the adrenal cortex release the end product of the HPA-axis, glucocorticoid hormones, of which the human variant is called cortisol – a process which is significantly slower and longer lasting than that governed by the ANS (Ulrich-Lai and Herman, 2009).

Stress reactions can largely be divided into two groups; systemic stress which is constituted by an immediate threat to the system e.g. loss of blood, pain or infection, and psychogenic stress which is rather caused by an anticipation of a threatening situation. While the activation of systemic stress is

mostly based on reflexes, psychogenic stress, such as threatening social situations, requires more complicated appraisal processes. This appraisal process is mainly carried out by structures in the brain's limbic system. The triggering limbic structure is the amygdala, often somewhat misleadingly called the brain's fear center, while two other structures, the hippocampus and the medial prefrontal cortex act as feedback mechanisms, which control and eventually terminate the HPA-axis (Ulrich-Lai and Herman 2009; Rubin et al 1966). In the context of this paper, the hippocampus is the most interesting structure of the three areas.

The function of the hippocampus is dependent on neurogenesis, which is the forming of new neurons. This means that its operability is reflected by its size. It simply grows when used, as it forms new neurons. Thus, it has been shown, that licensed London Cab drivers, who need to have an extensive amount of spatial information stored in their memory, have an enlarged hippocampus, and that the size of their hippocampus correlates with the time spent as a cab driver (Maguire et al. 2000). Conversely, prolonged stress with an elevated level of cortisol decreases the volume of the hippocampus and sometimes causes permanent brain damage. This creates a negative downward spiral. As the hippocampus gradually decreases, its ability to act as a feedback mechanism for the HPA-axis is diminished as it loses volume, causing cortisol release to be increasingly out of control, putting further cortisol load on the hippocampus, leading to further degradation, and so on (Conrad 2008).

As can be seen, the two early stages of AD are dominated by a loss of abilities that match the function of the hippocampus; problems with short term memory, problems with orientation and way finding, and problems with handling stress, resulting in aggression.

In the design of nursing homes for demented patients, much effort has been put into handling forgetfulness and loss of way-finding abilities. However, addressing the third property of the hippocampus, its role as an inhibiting feedback mechanism, which limits the release of cortisol by dampening the activation of the HPA-axis, should perhaps have a higher priority.

Cortisol release can lead to a negative spiral of stress in AD patients with a reduced hippocampus, as described above. This inflicts further damage on the hippocampus, because of the impact of an ever more uncontrolled cortisol release relative to the decreased volume of the compromised hippocampus, thereby accelerating the course of the disease.

The crucial question must therefore be, whether it is possible or not through architectural design, to influence the HPA-axis, and thereby the release of cortisol.

## Experiment:

While a lot is known about stressors, very little is known about to which extent the spatial context of a stressful episode might influence the activation of the SNS and HPA-axis.

To investigate this question, we conducted a laboratory experiment in which stressors as well as the spatial context could be controlled. Psychogenic stressors have shown to be stronger than physical stressors. Among the psychogenic stressors, the strongest are firstly psychosocial stressors, like performing or presenting something that is evaluated by peers and which have influence on one's hierarchical position; and secondly stressors of unpredictability, in which a behavioral response cannot affect the outcome (Dickerson and Kemeny 2004). We therefore chose to work with psychoso-

cial stress, using the Trier Social Stress Test (TSST), which is a standard stress test that has probably been the most used protocol for laboratory experiments with psychosocial stress since the early 1990's (Kirschbaum et al. 1993).

The protocol of the TSST combines two strong psychosocial stressors. The participants must complete two tasks in front of a 'committee', consisting of two or three persons, which constitutes the social evaluation. Typically, the committee has consisted of trained actors allowed only to address the participant with a set of standard lines and not to show any emotional expression in terms of facial expressions or gestures. The laboratory set-up comprises a preparation room and a test room, in which the committee is placed. During the test, data can be collected in terms of questionnaires and/or physiological measures. After a baseline recording which takes place in the preparation room, the participant is called into the test room. The 'chairman of the committee informs the participant that s/he has to perform two tasks in front of the committee. The participant is informed that the first task will be to introduce him or herself for 5 minutes as if applying for a job; the participant is not informed about the content of the second task. After 5 minutes of preparation, the participant is again called into the test-room and delivers his or her presentation. S/he is then given the second task, which is to count backwards, in steps of 13 from 1687, for 5 minutes. Each time s/he makes an error, s/he is told to start over again. As this task is nigh impossible for most if not all, the participant will therefore experience being socially evaluated by the committee on a task, which s/he cannot complete successfully. The participant then returns to the preparation room and rests for 40 minutes, while the stress reaction slowly decreases.

A virtual reality version of the TSST has been developed at Lund University in Sweden, the VR-TSST, using a Cave<sup>TM</sup>. The Cave is a laboratory setting in which a number of computer-coordinated projectors project onto three screens and the floor, so that a participant wearing special 3D glasses and a head tracker device will experience the scene as a three-dimensional space (Jönsson et al. 2010, Wallergård, 2011). Because the space in which the VR-TSST takes place is computer generated, it is possible to vary the space systematically. Referring to the fight- or flight behavior, we made two different test rooms; one with no openings and one with openings through which the floor of the space seemed to continue uninterrupted to the horizon, potentially allowing for escape (fig. 1). No objects were placed outside the test room. The openings and the sky were neutral to ensure that nothing outside the test room could elicit an approach or avoidance behavior. The aim was to test the hypothesis that psychosocial stressed participants in the closed room would respond with a more pronounced SNS and HPA-axis reactivity than participants who were tested in the open room. For a more thorough description, see Fich et al. 2014.



Figure 1. The enclosed room and the room with openings. Due to the stereoscopic projection, the participant will experience a clear 3D environment, in which the floor continues unhindered to the horizon through the openings.

## Results:

Although the SNS and the HPA-axis are often thought to work in parallel, they did not in this case. As can be seen (fig. 2) neither part of the ANS reacted with any significant difference depending on the type of space. However, as can be seen from the cortisol reactivity, the HPA-axis showed significant difference in activation that depended on whether the test was performed in the closed or open space. Moreover, it seems that the enclosed-room group takes approximately double the amount of time to get down to their cortisol baseline than those, who had undergone the VR-TSST in the open room.

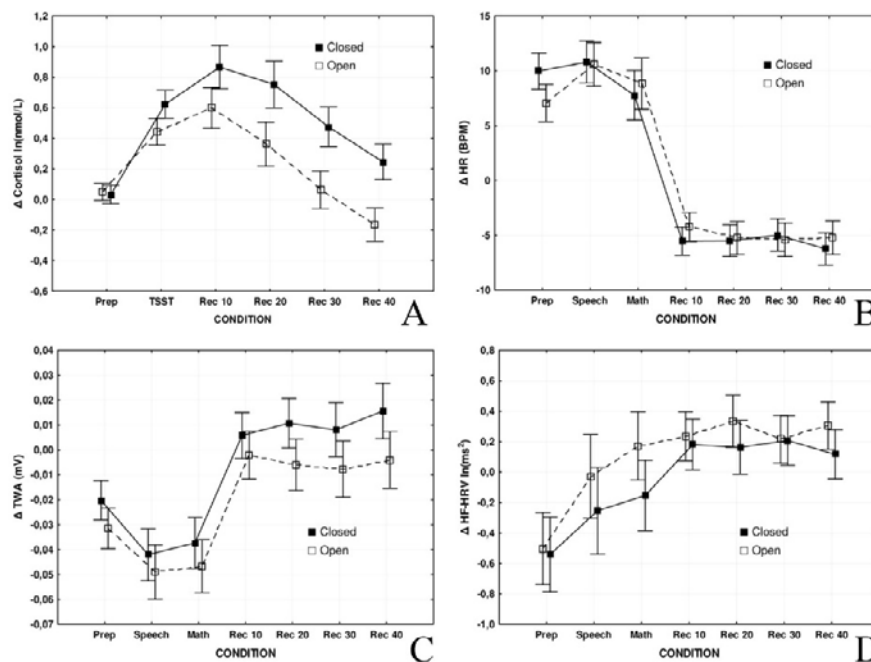


Figure 2. A) Shows the cortisol, which was measured in saliva samples. Due to a delay between the time cortisol is released into the blood stream and the time it shows up in saliva, "prep" is actually baseline and so on. B) is the heart rate, C) is SNS activity. When the curve goes down, the activity of the SNS goes up. D) is PNS activity. SNS and PNS activity was derived from heart rate variability

As can be concluded, it is possible through the architectural design of a space, to influence the amount of cortisol released and the duration of enhanced cortisol level in connection with a psychosocial stress episode.

## Discussion

Obviously, an experiment such as this has strong limitations and can only be seen as a pilot study, suggesting a possibility and needing much further research to be substantiated. The laboratory setting used is very simplified compared to a real-life situation. The participants were not AD patients, but perfectly healthy young male university students and so on. Nevertheless, the experiment addresses some very basic functions within the human neurophysiology.

Stress is a threat to health and well-being in itself and it is a growing problem within most developed Western societies. The recognition that it might be possible to reduce stress in terms of cortisol release with architectural design suggests that a dedicated use of such design parameters might enable the design of buildings to contribute to a diminishment of psychosocial stress. The relation between stress and effects on the immune system is well established (Seegerstrom and Miller 2004). Prior research has for example

shown that examination stress has a negative impact on wound healing (Marucha et al. 1998; Glaser et al. 1999). Thus, the use of design principles which lessen cortisol secretion during stress will have obvious advantages e.g. in hospitals and in connection with the working environment.

However, the development of stress-reducing design principles might be even more important in diseases such as AD, considering the health care challenges posed to society by AD.

The societal benefit of research into the influence of architectural design on stress seems promising. For AD patients, it will ease the emotional strain of stress and aggression, as long as the disease is still at a stage where this is possible. Helping to avoid aggression and contributing to a slower progression of the disease, perhaps as an integrated part of a wider therapeutic program, would ease the burden of care. Seen in relation to the extent of the challenge and the number of care facilities that will need be built, knowledge of this kind will undoubtedly be beneficial for everyone involved in planning and designing those facilities. Our small sample study can only be seen as a first demonstration of the connection between the design of spaces, the potential behavior within them, and the physiological and psychological effects of stress. Substantial further research is needed to get a more thorough understanding of this interaction, and how these effects work outside the laboratory. In addition to this, in the case of AD, perception may be progressively compromised as the disease progresses, and thereby the appraisal of social situations and the spatial environment in which they take place. Systematic research in perception, appraisal of social situations and the spatial environment is therefore also needed.



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# Medical Neighbourhoods: Urban Planning and Design Considerations for Charité Virchow Klinikum in Berlin, Germany

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## Abstract

*In Berlin Germany, more than 60% of patients suffer more than one disease or condition (multi-morbid) requiring different specialists to attend their health needs in a coordinated manner. Unfavourably, more than 70% of care is delivered in solo-offices spread-out in a vast urban landscape whilst only 30% of care concentrates in large hospitals offering better chances of coordinated care.*

*A medical neighbourhood is a clinical partnership model seeking to coordinate health services at all levels of care with a patient-centred focus. It aims to overcome the most relevant issues towards reaching sustainable health systems such as: poor patient care coordination; unnecessary hospital admissions and readmissions; long waiting times; waste in healthcare spending; poor evaluation processes; and many others that lead to increasing costs.*

*Until now what remains overlooked in implementing this care model, and main purpose of the study, is improving the physical environment of neighbourhoods to first, protect the health of residents (health promotion) and second, support a patient-centred approach based on: (a) building medical teams around patients' needs for medical care and disease prevention, and (b) ensuring users' (staff, patients, other) journey quality experience from service to service.*

*Therefore, an evaluation study was conducted in two neighbourhoods in the vicinity of Virchow Klinikum Charité Medical University covering two main objectives:*

- *Map neighbourhood environment functions and services which offer or facilitate healthier lifestyles, disease prevention, and clinical care; and*
- *Assess physical features and characteristics of the street network to determine levels of pedestrian friendliness (walkability)*

*1.02 Km<sup>2</sup> of urban surface including 40 street blocks, 42 streets, 102 street segments, and 77 crossing situations, were systematically surveyed finding conclusive evidence that developing a medical neighbourhood physically in the area is necessary and feasible.*

*Keywords: Health System, Urban Health, Urban Development, Urban Design, Walkability*

# Introduction

A Medical Neighbourhood as defined by the PCPCC (Patient-Centered Primary Care Collaborative (PCPCC), 2015), is a clinical partnership seeking to coordinate primary and secondary care services, within a same building complex, or geographically spread-out, often the case of Berlin and for Germany in general (Hirsch et al., 2012). A patient-centred medical home (PCMH) is the main component of the partnership which acts as a central hub linked to other health services usually through sophisticated health information technologies (HIT).

The main objective of a medical neighbourhood is to overcome common issues for most health systems towards reaching sustainability such as: poor patient care coordination due to fragmented services; low health literacy hindering disease prevention and health promotion; waste in healthcare spending from unnecessary procedures and treatments; lack of transparency due to poor evaluation processes or organizational secrecy; and many others that lead to increasing costs as further explained in the background.

Following this particular definition, implementation efforts to strengthen relationships across different providers have produced guidelines and protocols mainly on: coordination mechanisms for information reliability; care delivery; communication flow; and shared accountability (Alidina, Rosenthal, Schneider, & Singer, 2016). An example of guidelines emphasizing the reciprocity of responsibilities and the importance of reliability among care providers, is found in the conceptual framework *Good Neighbours* developed in 2010 (Hoangmai, H., 2010).

In Germany, a similar integrative effort was introduced in 2004 called *medical care centers* (MVZs), where medical staff from different disciplines are contracted mainly aiming to reduce costs, service proximity, and waiting times. Since then, these centers have raised criticism especially from solo-office physicians which perceive them as a proliferation of small hospitals different to the decreasing numbers of family doctors (Woebkenberg & Schneider, 2015).

Differently, the thesis of this research understands the medical neighbourhood not as a health management company competing with solo-offices, nor as a health provider solely for primary and secondary care. It advocates for physically building a continuum of care in the neighbourhood by linking its numerous individual medical establishments, a PCMH, and the main hospital, through health promoting public spaces. In its ambition, it aims to create a voluntary doctor-patient-citizen network encouraged by cost reductions policies and improvement of health and health-related outcomes.

At early stage, this evaluation study assesses the actual state of two neighbourhoods in Berlin close by a main health care centre: the Charité Virchow Klinikum (a 2.000 bed, state owned university hospital). Through a systematic observation method called Walkability for Health, it questions – at three urban scales (macro, meso, micro) – the possibility of physically developing a medical neighbourhood on the site based on reviewing (a) the availability and proximity of health-related destinations conducive to healthier behaviours (lifestyle) and providing all levels of disease prevention and clinical care including a PCMH, and (b) the conditions of the neighbourhood environment for high quality biking and pedestrian experience, and public transportation usage over car dependency.

This study aims high at being a significant contributor to people-centred approaches for urban development and urban health such as the Healthy Cities concept developed by the World Health Organization (WHO). It follows its recommendations on designing environmental interventions to benefit and protect individual people's health and quality of life through creating walkable cities (WHO 2016).

# Background

## The need for transformational change

The point of departure for this study is to understand first, the actual state of health care delivery in Berlin which derives directly from eight main problems and organizational issues of the German health system, and secondly, two concepts crucial in physically developing a medical neighbourhood, the value-based agenda, and urban walkability.

## Eight issues

To better understand the nature of the following 8 problems and a possible holistic solution, a theoretical framework has been prepared (see figure 1) under the following rationale: avoid overuse of the actual health care system focused on disease (with a pathogenic approach) by implementing a salutogenic ecosystem focused on attaining positive health of contributors through urban development. Therefrom, the importance of including in the evaluation process physical features of a medical neighbourhood model and a walkability perspective as further on explained in the approach.

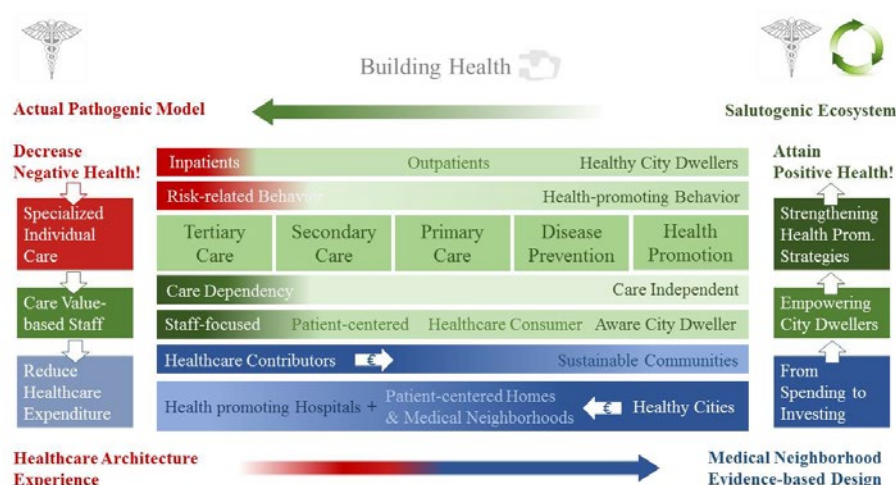


Figure 1. Salutogenic Ecosystem Model (Á. Valera Sosa, 2015)

- (1) As the WHO (2014) reports, a relatively small group of non-communicable diseases (NCDs) are responsible for approximately 86% of the deaths and 77% of the disease burden; to which 80% of its risk factors are life-style related and avoidable (WHO, 2017).
- (2) A large proportion of the population faces retirement whilst the working-age population consistently decreases. As consequence, home care and institutional care will increase (Schulz, 2010) with lesser security benefits to its recipients (Federal Statistical Office, 2015).
- (3) In spite of high rates of lifestyle and age-related NCDs health cost reduction policies focus on reducing hospital inpatient care (OECD, 2014) without clear policy on improving outpatient care.
- (4) Health policy has a clear pathogenic approach over a salutogenic one. The amount of avoidable disease in Germany accounts for 80% of all healthcare costs (EU Commission 2014). Anyhow, only 3,3% of the total



health expenditure is from disease prevention and health promotion strategies (OECD, 2014).

(5) Care staff capacity is overloaded and year by year suffers shortage. The number of patients per week is of 243 when in other OECD countries ranges between 102-154 and contact times between general practitioners (GPs) and patients are less than 8 min when in other OECD countries is between 11-19 min. The total workload of GPs is of 50,6 hours a week, again above the EU average.

(6) Conservative policy limits the introduction of new integrated health business models. The German Federal Ministry of Health (BMG) has a clear organizational structure that facilitates the supervision and regulation of hospital systems and clinics meanwhile local authorities (Länder) – with a better insight for local needs and bidding processes - are responsible for provision of care (The Economist, 2015).

(7) Healthcare services are highly fragmented; 70% of primary care physicians and 75% of secondary care physicians practice in solo offices (Hirsch et al., 2012). As a result, multi-morbid patients are mostly attended by single diseases with serial care instead of their health being managed employing parallel care (Schlette, Lisac, & Blum, 2009).

(8) In the system, health and economic outcomes are punishing to evaluate, for a similar health service or condition the system allows two processes (The Economist, 2015): a DRG (disease-related group) system for inpatient care, and out-of-pocket for service for outpatient care.

### A medical neighbourhood's components

Aiming a needed transformational change, this study elaborates on how *medical neighbourhoods* can be a sustainable health system when built on the strongest pillars of any country's economy: the health care and urban development sectors.

The term is conceptualized from the six components of The Value-based Agenda as introduced by Michael Porter and Elizabeth Teisberg in their book *Redefining Health Care* from 2006. Since first published, many are the providers and organizations that have implemented its principles, especially for specific disease groups or conditions such as the Sun Yat-Sen Cancer Center in Taiwan for breast cancer, the Boston Children's Hospital in the USA for plastic, oral and orthopaedic surgery, and The West German Headache Center in Essen for integrated migraine care.

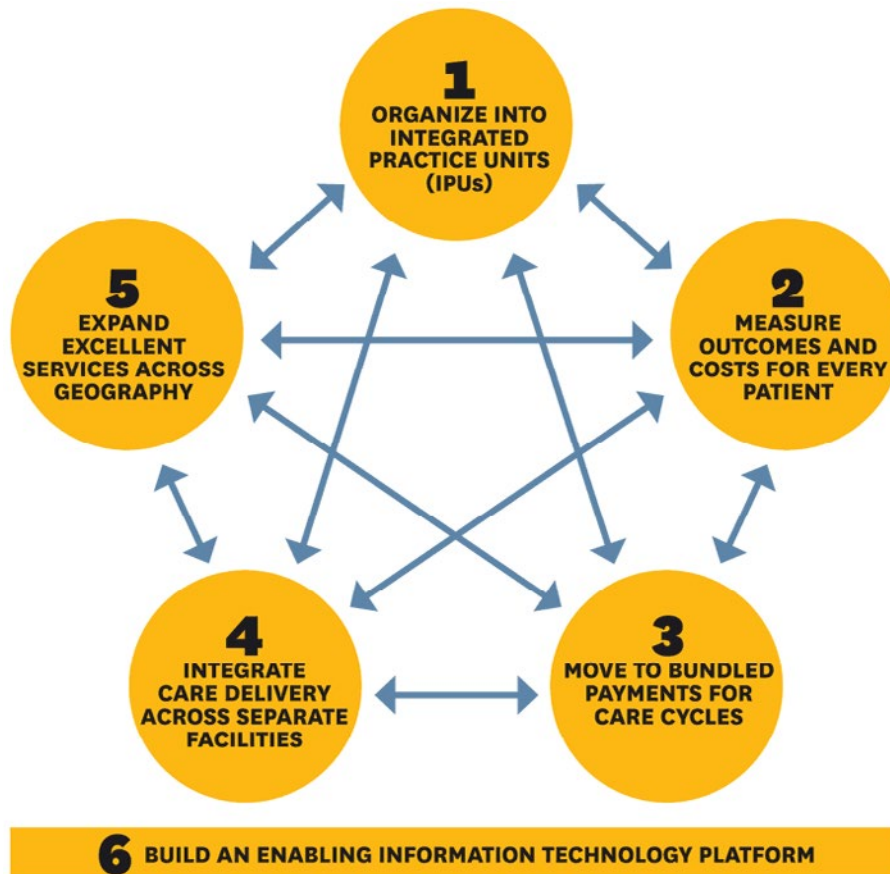


Figure 2. The Value-based Agenda (Porter & Lee, 2013)

Six are the components to a medical neighbourhood, according to Porter and Teisburg (see Figure 2) in the article “The Strategy that will fix Health Care” (Porter & Lee, 2013). Based on descriptions to all six components, this work includes in the evaluation process aspects from components 1, 4, and 5 which have a clear urban and architectural design importance.

The first refers to integrated practice or parallel care instead of serial care. This means shifting from today’s fragmented health system of solo offices to a patient-centred care centre organized around the patient’s medical condition. This structure is called an integrated practice unit (IPU) or a patient-centred medical homes (PCMH) according to the U.S. Department of Health & Human Services.

The second and third are about measuring outcomes and costs for every patient, and bundled payments for care cycles, respectively.

The fourth is the integration of care across physically separate facilities and organizations by (a) defining the scope of services, (b) concentrating volume in fewer locations, (c) choosing the right location for each service line, and (d) integrating care for patients across locations.

The fifth claims an expansion of health services across a neighbourhood’s geography in two models. The first called a hub-and-spoke model, where satellite facilities to a main PCMH are established and staffed at least partly by clinicians and other personnel employed by the parent organization; the second called a clinical affiliation, in which the PCMH partners use facilities from other organization rather than adding capacity.

The sixth, is common to many of the implementations realized so far: a health information technology (HIT) platform across all previous components that support integrated multidisciplinary care.

To physically implement this agenda, urban planning and design considerations must be formulated in terms of developing a PCMH linked to the

spread-out health-related services and functions of Berlin's healthcare landscape with special considerations on the needs and requirements of vulnerable user groups such as children, elder, and impaired (physically and/or cognitively). Here lies the critical importance of urban walkability.

### Urban walkability

The vision of a well-connected pedestrian-friendly medical neighbourhood is all but a simple task. It is about creating built environments conducive for people to walk and live a healthier life style. Anyhow, as researcher and author Jeff Speck assures, the pedestrian is an extremely fragile species that under the right conditions thrives and multiplies (Speck, 2012).

Walkability is both as concept and a measuring tool which comprehensively explains how friendly the physical environment is for walking and/or biking (including variations such as canes, walkers and wheelchairs). The Transport for London Agency (2005) states that walkability is beyond measuring features which ensure pedestrian-path-safety and more about knowing to what extent walking is readily available as a connected, accessible, and pleasant mode of transport.

Anyhow, walkability is not only a term employed in transportation planning but also a strategy adopted by many health agencies, such as WHO and the Center for Disease Control and Prevention (CDC), which advocate for increasing neighbourhood walkability primarily to promote fitness, combat obesity, and enhance sustainability (Rattan, Campese, & Eden, 2012).

In a glance, the socio-economic determinants of health as defined by WHO, have great similarities to the long list of environmental, economic, social, and health impacts of walkability. Thereby, the urban layout of a medical neighbourhood or a healthy city should be of a walkable neighbourhood. But then, what makes a neighbourhood more walkable and less car dependent than others?

Since the mid-90s walkability research has incessantly tried to determine what built environment factors stimulate pedestrian activity and trigger path preference. Since then, many rating and auditing instruments characterizing the built environment have proliferated, describing urban and sub-urban situations at three city scales: the macro, meso, and micro scales.

The observation method used in this study (Walkability for Health) includes in its evaluation criteria the most common physical environmental indicators found in walkability literature over the past two decades which consistently explain walking and biking rates in urban areas.

# Approach

The main purpose of the study was to deliver recommendations on how to improve the physical environment of a particular neighbourhood to first, protect the health of residents (health promotion) and second, support a patient-centred plan based on: (a) building medical teams around patients' needs for medical care and disease prevention, and (b) ensure users' (staff, patients, other) journey quality experience from service to service.

The purpose demanded two clear main research objectives:

1. estimate the availability and proximity of neighbourhood health-related destinations within a (a) *food environment* supporting good nutrition, (b) *social environment* improving community cohesion, (c) *active environment* conducive to more physical activity levels and a healthier lifestyle, and a (d) *health care environment* providing disease preventive and clinical services
2. assess the conditions of the neighbourhood environment that ensure high quality biking and pedestrian experience, and public transportation usage especially for vulnerable user groups (children, elder, and physically and/or cognitively impaired)

To approach both the purpose and its main objectives, a systematic observation method called Walkability for Health was designed to gather and graph primary and secondary data at three urban scales.

At the macro scale, finding urban form factors such as, street density, transportation diversity, and urban grid designs (Cervero, 2003) which significantly impact the proximity and directness of travel between destinations (Frank, Kavage, Devlin, & Marmot, 2012). At the meso scale, where street elements at road segments and intersections, determine the degree of path continuity and block-to-block connectivity for active travellers (Moudon & Lee, 2003). Finally, the micro scale, describing design features at neighbourhood destinations and points of interest along routes which ensure universal access and safety; environmental comfort; and a pleasant visual structure of the physical environment (Ewing, Handy, Brownson, Clemente, & Winston, 2006).

The method helped to effectively:

- Map physician solo-offices
- Map functions and/or services conducive to protective health behaviours and healthier lifestyles such as, diet, positive social interactions, and physical activity
- Determine the pedestrian friendliness of the street network in terms of its path continuity and block connectivity, safeness, comfort, and visual structure of its elements
- Select a site to develop a medical centre for integrated care (a PCMH for primary and secondary care)

The complete evaluation research required a total of 21 Assessment sheets be prepared to collect data (see table 1): 8 assessment sheets for the macro scale; 7 for the meso scale; and 6 for the micro scale.

For the macro and meso levels, 15 types of assessment sheets were used to collect secondary data from public databases. For the micro level two sur-

veyors were instructed to collect primary data in 6 types of sheets using photography and annotations.

The data collected from the assessment sheets were organized in 11 tables (see tables 2 to 12) which generated a conclusion map at each scale respectively. Each map graphed important physical environmental factors for active travelling (mainly walking, biking, and commuting), and for health-protective behaviours (such as services for self-management) and health-promoting behaviours (mainly healthy eating, positive social interactions, and physical activity). The maps were analysed to progressively narrow down the study area into specific street segments and points of intervention (POI).

The macro conclusion map (see figure 3) showed: first, proximity between the hospital's main entrance and the vacant plots for the future PCMH considering a 600 m pedestrian catchment area; and second, proximity of the plots to public transportation hubs, and to areas dense with health-related destinations (services or settings for care, disease prevention, and health promotion). On top of public transportation proximity, three levels of access to the hub or transport unit were taken into account: easy street-level access (e.g. trams); moderate difficulty of street-level access (e.g. buses); and difficult access (e.g. underground and trains). The proximity, density, and access analyses, formed the criteria to select plots for exclusion or inclusion and to visualize where health-related destinations were provided or not.

The meso conclusion map (see figure 4) represented the plots pre-selected, the street classification of the site, and its pedestrian crossings at street intersections. 40 blocks, 42 streets, 102 street segments and 77 crossing situations were analysed. Streets were classified in nine groups following the presence or absence of its main elements (such as, pedestrian strips, bike lanes, furniture strips, building strips, buffers, etc). Pedestrian crossings (including bike lane crossings) were described by its visibility degree, if these were pedestrianized (levelled-up), fully marked (coloured), simple marked (striped), or if it had no markings at all. The information helped understand how and where the street network was supporting active transportation or not. Together with the macro information, some routes were selected for further study at the micro scale and the plot for future development was selected.

The micro conclusion map (see figure 5) prioritized those routes (by street segments), crossings, and other POI relevant to improve walkability levels towards the medical neighbourhood's settings. The routes were traced by connecting the selected PCMH plot to the hospital's main entrance, major transportation hubs, public open spaces, and areas with health-related destinations. The POI were spaces or places of stay where active travel would pause, generally induced by entrances to destinations or crossings. At these points, environmental conditions for pedestrians (such as safety, comfort, and visual structure) were assessed using Likert scale and photographic surveys.

Table 1: Assessment sheets

Macro Form Factors	
Study Area	A_Site Map
Density	A1a_Population Density (Results Table 1) A1b_Density of Uses and Services (health-related destinations; Results Table 1) <ul style="list-style-type: none"> <li>• Active Environment</li> <li>• Food Environment</li> <li>• Social Environment</li> <li>• Healthcare Settings</li> </ul>
Diversity	A1c_Street Density (Results Table 1) A2a_Public Transportation Provision (Results Table 2) A2b_Public Transportation Coverage (Results Table 3)
Design	A3a_Street Layout (Results Table 4) A3b_Building Layout (Results Table 4)
Macro Conclusion Map	A4_ Medical Neighbourhood Context Map
Meso-level Street Patterns	
Street Network	B1a_Street Hierarchy & Classification (Results Table 5) B1b_Blocks & Street Segments (Results Table 6)
Block Connectivity	B2a_Pedestrian Crossings Analysis (Results Table 7) B2b_Street Intersections Summary Map
Path Continuity	B3a_Street Main Element Analysis (Results Table 8) B3b_Street Space Allocation (Results Table 8) B3c_Street Pattern Summary Map
Meso Conclusion Map	B4_ Continuity & Connectivity Analysis Map
Micro Design Variables	
Safeness	C1a_Universal Access (Results Table 9) C1b_Signage and Signalization (Results Table 9) C1c_Sightline (Results Table 9)
Comfort	C2a_Spatial (complement of B3b, Table 10) C2b_Respite Areas, Noise Levels & Light Quality (Results Table 10)
Visual Structure	C3a_Enclosure, Transparency, Complexity & Human Scale (Results Table 11)
Micro Conclusion Map	C4_ Pedestrian Environment Summary Map

# Results

Table 2. Macro Form Factors – Density

Population (A1a)		1,750,922 / ha. (Population Density 2015, Fis-Broker)		
Density	Uses and Services (Health-related destinations; A1b)	4 uses (Actual Use of Built-up Area 2010, Fis-Broker)	Amount	
			Active Environment	12 (maps.me)
			Food Environment	46 (maps.me)
			Social Environment	56 (maps.me)
			Healthcare Settings	17 (maps.me & Gelbe Seiten)
	Street (A1c)	T-junctions: 26 (Google Maps) Crossroads: 23 (Google Maps)		

Data: Assessment sheets A1a, A1b, and A1c

Population density of the site is higher than the Berlin average level of 394,760 per hectare. With four uses being recognized (residential, public facilities, mixed uses, green and open space), residential use is the most prevalent of this site. The street density is high, as most closed-edge block neighbourhoods in Berlin, favouring pedestrian path options and flow. For both streets there are 26 T-junctions and 23 crossroads, evenly distributed.

Table 3. Macro Form Factors – Diversity – Transportation Provision (Stations and Stops)

Transportation Availability	Active	Walking	Yes
		Biking	Yes
	Public	Regional Trains	No
		S-bahn	Yes
		U-bahn	Yes
		Trams	Yes
		Buses	Yes
	Private	Car-sharing	Yes
		Taxis	Yes
		Privately-owned vehicles	Yes

Data: Assessment sheet A2a

The site supports active, public, and private transportation. All modes of public transportation, except regional trains, are available on this site. With 6 day lines and 3 night lines (altogether 11 stops), bus services are the most prevalent public transportation on this site.

Table 4. Macro Form Factors – Diversity – Transportation Coverage

		Percentage (%)
Public Transportation Coverage (Pedestrian Catchment)	Regional Trains	0
	S-bahn	20
	U-bahn	40
	Trams	50
	Buses	100

Data: Assessment sheet A2b

The site is fully covered by public transportation services. Bus services provide 100% coverage to the site, making it not only the most available but also the mode of public transportation with the most pedestrian catchment area.

Table 5. Macro Form Factors – Design

Street layout	Deviations	0 (Google Maps)
	Dead Ends	2 (Google Maps)
Building layout	Building area	726,177 m <sup>2</sup> (Fis-Broker)
	Void area	683,823 m <sup>2</sup> (Fis-Broker)
	Building/void ratio	1:0.9
	Green void area	24,318 m <sup>2</sup> (Fis-Broker)
	Grey void area	659,505 m <sup>2</sup> (Fis-Broker)
	Green/grey ratio	1:27

Data: Assessment sheets A3a and A3b

Only two dead ends are found; one of them leads to a children's playground which actually benefits pedestrians.

Building area and void area almost take up the same amount of land respectively in the site. Out of the total void area of 683,623 m<sup>2</sup>, only 1 m<sup>2</sup> of green void area is found for every 27 m<sup>2</sup> of grey surface.

Table 6. Meso-level – Street Network – Street Hierarchy and Street Classification

		Amount
Street hierarchy	Arterial	0
	Collector	5
	Local street	16
	Supplementary road	6
Street classification	Transit corridor	1
	Downtown corridor	4
	Downtown two-way street	1
	Neighborhood main street	3
	Neighborhood street	13
	Boulevard	2
	Downtown one-way street	0
	Commercial alley	0
	Yield street	3
	Residential shared street	0
	Commercial shared street	0
	Green alley	0

Data: Assessment sheet B1a



There are 5 collectors in total. Seestraße and Müllerstraße at the perimeter of the study area; Föhnerstraße, Amrumerstraße, along with Seestraße framing the hospital; and Luxemburgerstraße separating both Kiez.

Amrumer Straße, Föhner Straße and Luxemburger Straße, which all are downtown corridors, lay between Virchow-Klinikum, Brüsseler Kiez, and Sprengelkiez. Tram services are provided along the only transit corridor (a collector) of this site, Seestraße. On the other hand, Müllerstraße (also collector) is recognized as a downtown two-way street. Besides, there are two residential boulevards in Brüsseler Kiez: Lütticher Straße and Antwerpener Straße where strips of public open spaces are found in the middle of both of them respectively.

Table 7. Meso-level – Street Network – Blocks and Street Segment

No. of blocks	40 (Fis-Broker)
No. of street segments	102 (Google Maps)

Data: Assessment sheet B1b

There are 40 blocks and 102 street segments on the site. The blocks in Brüsseler Kiez resemble a grid of squares while those in in Sprengelkiez are larger and relatively irregular in shape.

Table 8. Meso-level – Block Connectivity – Pedestrian Crossings Analysis

	Amount
Pedestrianized	15
Fully marked	3
Marked pavement	77
No markings	142
Dead end	29

Data: Assessment sheet B2a

The majority of the pedestrian crossings are unmarked, nearly doubled the amount of marked pavements whereas only 15 crossings are pedestrianized.

Table 9. Meso-level – Path Continuity – Street Main Elements Analysis

	Amount
1A_ Pedestrian zone + bike lane with buffers	0
1B_ Pedestrian zone with buffer + bike lane	0
1C_ Pedestrian zone with buffer	16
2A_ Pedestrian zone + bike lane with buffer	1
2B_ Pedestrian zone + bike lane	0
2C_ Pedestrian zone	0
3A_ Pedestrian strip + bike lane with buffer	29
3B_ Pedestrian strip + bike lane	0
3C_ Sidewalk or pedestrian strip	67

Data: Assessment sheet B3a

Most of the streets of the site are sidewalks or pedestrian strips (3C) where bike lanes are not provided. While streets within Brüsseler Kiez are all pedestrian strips, there is a mix of pedestrian zones plus bike lanes with buffer (2A) and pedestrian strips within Sprengelkiez. All collectors except Am-

rumer Straße and Müllerstraße are without bike lanes. Besides, a discontinuous bike lane is also observed on Nordufer and Sylterstraße.

Table 10. Micro Design Variables – Safeness

Safeness			
Point of Interest (POI)	Universal access	Signage and signalization	Sightline
1 (R1)	yes	yes	clear
2 (R1)	yes	yes	clear
3 (R1)	yes	yes	clear
4 (R1, R3)	yes	yes	clear
5 (R1, R4)	yes	yes	very clear
6 (R1)	yes	yes	very clear
7 (R1)	yes	yes	very clear
8 (R1)	yes	no	very clear
9 (R2)	no	no	clear
10 (R2)	yes	no	clear
11 (R3)	no	no	clear
12 (R2, R3)	yes	no	clear
13 (R3, R5)	no	yes	not clear
14 (R4)	yes	yes	clear
15 (R4, R5)	yes	yes	very clear
16 (R2, R4)	yes	yes	clear
17 (R4)	yes	yes	clear
18 (R5)	yes	no	clear
19 (R5)	yes	no	clear
20 (R4)	yes	yes	clear
21 (R4)	yes	no	very clear
22	yes	no	clear
23	yes	yes	clear

POI = Point of interest

Data: Assessment sheets C1a, C1b, and C1c

Only two of all POI do not provide universal access. Almost half of the POI do not have signage and signalization. Sightlines are either clear or very clear at all points.

Table 11. Micro Design Variables – Comfort

Comfort							
Point of Interest (POI)		Spatial comfort	Respite areas	Noise levels		Light Quality	
				D	N	D	N
1	(R1)	✓	xx	x	•	✓✓	•
2	(R1)	✓	xx	•	✓	✓	•
3	(R1)	✓	xx	•	✓	✓	•
4	(R1, 3)	✓	xx	•	•	✓✓	•
5	(R1, 4)	✓✓	•	•	•	✓✓	•
6	(R1)	✓	x	x	•	✓✓	•
7	(R1)	✓✓	xx	x	✓	✓	•
8	(R1)	✓	•	•	✓	✓✓	x
9	(R2)	✓	✓	•	✓	•	x
10	(R2)	✓	•	•	✓	•	x
11	(R3)	✓	✓	•	✓	•	x
12	(R2, R3)	✓	•	•	✓	•	x
13	(R3, R5)	✓	•	•	✓	•	x
14	(R4)	✓	x	x	•	✓✓	•
15	(R4, R5)	x	xx	x	•	•	•
16	(R2, R4)	x	xx	x	•	•	•
17	(R4)	xx	xx	x	•	✓	•
18	(R5)	•	✓✓	✓	✓	•	•
19	(R5)	✓✓	xx	•	✓	✓	•
20	(R4)	•	xx	x	✓	•	•
21	(R4)	x	xx	xx	x	✓✓	•
22		•	xx	•	✓	•	•
23		✓	x	x	✓	•	•

POI = Point of interest; D = Daytime; N = Night time

✓✓ Very Suitable ✓ Suitable • Moderate x Unfit xx Very Unfit

Data: Assessment sheets C2a and C2b

Although spatial comfort at POI are suitable in general, respite areas are unfit or very unfit at most points. Noise levels are higher during daytime while lower during night time. Higher noise levels are found at POI which are located on collectors. Light quality during day time on wider streets and open spaces is brighter than those within the two neighbourhoods whereas it is moderate in general at night.

Table 12. Micro Design Variables – Visual Structure

		Visual structure			
	Point of Interest (POI)	Enclosure	Transparency	Complexity	Human scale
1	(R1)	open	30%	simple	no
2	(R1)	moderate	25%	moderate	no
3	(R1)	moderate	25%	moderate	no
4	(R1, R3)	moderate	35%	moderate	no
5	(R1, R4)	open	35%	simple	no
6	(R1)	open	40%	moderate	no
7	(R1)	moderate	55%	moderate	yes
8	(R1)	very open	10%	simple	yes
9	(R2)	enclosed	35%	moderate	yes
10	(R2)	enclosed	35%	moderate	no
11	(R3)	enclosed	35%	moderate	no
12	(R2, R3)	moderate	35%	moderate	no
13	(R3, R5)	moderate	35%	moderate	no
14	(R4)	open	65%	moderate	no
15	(R4, R5)	open	20%	very simple	no
16	(R2, R4)	open	20%	very simple	no
17	(R4)	very open	25%	simple	no
18	(R5)	moderate	35%	moderate	no
19	(R5)	enclosed	20%	simple	yes
20	(R4)	very open	15%	simple	no
21	(R4)	open	23%	simple	no
22		enclosed	20%	simple	no
23		enclosed	15%	simple	no

Data: Assessment sheets C3a

In general, the POI possess moderate to open level of enclosure; low to medium level of transparency; simple to moderate level of complexity; and low human scale.

# Conclusions

The following are descriptions at three scales that summarize the main findings of the evaluation study which led to a selection process to define (1) a plot for a PCMH, (2) routes for active travel and, (3) points of interest to be developed at pedestrian level.

## Macro scale conclusions

At this scale, the hospital and plots for the PCMH were mainly analysed in terms of proximity to health-related services and access to diverse public transportation hubs.

All plots measured had at least 5.000m<sup>2</sup>, sufficient surface area to build a PCMH. The smallest plot (plot D) is approximately 14.000m<sup>2</sup> and the largest (plot E) around 26.000m<sup>2</sup> (see Figure 3).

Virchow-Klinikum is bordered by street collectors that limit easy access to pedestrians. It has one main pedestrian-only entrance and two secondary ones. One of the secondary entrances is accessible for pedestrians, cars, and deliveries including a car parking lot. The other secondary entrance is accessible for pedestrians, cars and the only one for bikers. This situation limits a proper pedestrian travel (safe, comfortable and pleasant) to any of the five plots.

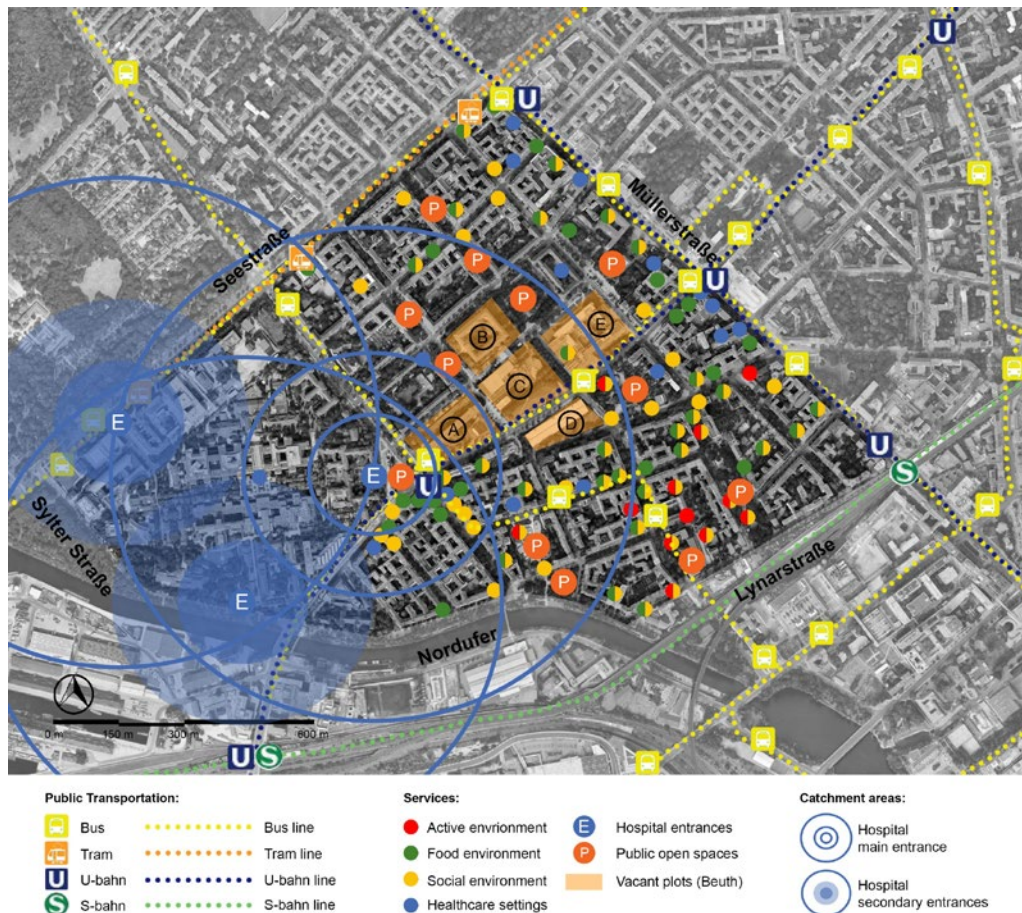


Figure 3. Macro Scale Conclusion Map

Public transportation in the area is served by 4 bus lines (including 1 night line), 2 tram lines, and 1 underground line having a complete coverage over the site. Although, the tram stop – having the friendliest accessibility for vulnerable groups - is the farthest to the hospital's main entrance and to the plots. Differently, the hospital and all plots except for B, have a privileged location towards the underground, although its entrances are not convenient for vulnerable groups.

Among the services found, around three fourths of the 56 stores and shops of the social environment are found in Sprengel Kiez, a similar proportion for the food environment, and almost 90% of all destinations of the active environment. The majority of solo offices or services for primary and secondary care are mostly distributed along Müllerstraße, a main collector which limits both Kiez in the East. Only three services in Brüsseler Kiez and five in Sprengelkiez are found on its local streets. In general, more than 65% of all stores, shops and services from all environments of both Kiez are beyond the 600m pedestrian catchment area from the hospital's main entrance and from plots A and B. In this case the most favoured is plot E.

The twelve open public spaces found, are half in Brüsseler Kiez being four predominately strips of unprogrammed green areas partly equipped with children playgrounds located along Lütticher Straße and Antwerpener Straße. The most relevant open public space at this Kiez is the Zeppelinplatz, which has been recently reequipped and renovated to serve as a multigenerational park. Virchow Klinikum and all plots are very close to this situation but, Virchow Klinikum and plot D are segregated by two prominent collector streets, Amrumer Straße and Luxemburger Straße, respectively.

In Sprengelkiez, Sprengelpark is the largest open public space, also recently renovated for different age groups. Another important park is Pekinger Platz, equipped for diverse formats of structured and unstructured play and age groups. The only plot nearby both parks is D.

From this macro analysis it was concluded that plots C and E were the strongest options for developing a PCMH mainly due to their proximity to a dense area of health-related services and parks, proximity to public transportation hubs, and large surface area ideal for a mixed used complex.

## Meso scale conclusions

The aim at this scale was to define routes fit for an active travel from plots C and D towards the hospital's main entrance and other health-related destinations.

After assessing 40 street blocks, 42 streets, 102 street segments, and 77 crossing situations, Plot E was found to have best block to block connectivity and path continuity over Plot C.

Plot E borders northwest with Limburger Straße, a very important local street heading straight to the hospital's entrance without deviations. Improvements to this 580 m street are critical to the medical neighbourhood's master plan. At this street, a pedestrianized crossing with Zeppelinplatz facilitates flow through this park to Ostenderstraße. At this street pedestrianized crossings keep helping the flow towards Antwerpenerstraße, an important connector to other neighbourhoods. Ostenderstraße also connects very well to Müllerstraße where most healthcare settings are located. Northeast of the plot, Genterstraße has crossings over a car parking island towards an open green public space –used as a local market- have no markings. This situation can be easily improved by pedestrianizing a midblock crossing directly to the market. This action would connect plot E with a very important social and

food asset of the neighbourhood. The plot borders southeast with Luxemburger Straße, an important street collector which 26 m width is a pedestrian barrier between both neighbourhoods due to first it's as broad crossings and second, its unbalanced space allocation favouring motorized vehicles. Southwest to the plot, a car free alley defines the boundary with Plot C.

Plot E holds a similar situation as Plot C although with few but very relevant differences. It does not have access to Genter Straße with its market situation and no direct contact to Zeppelinplatz.

The meso scale survey identified 5 main routes across the study site which conditions need to be improved for a well-connected and continuous active travel.

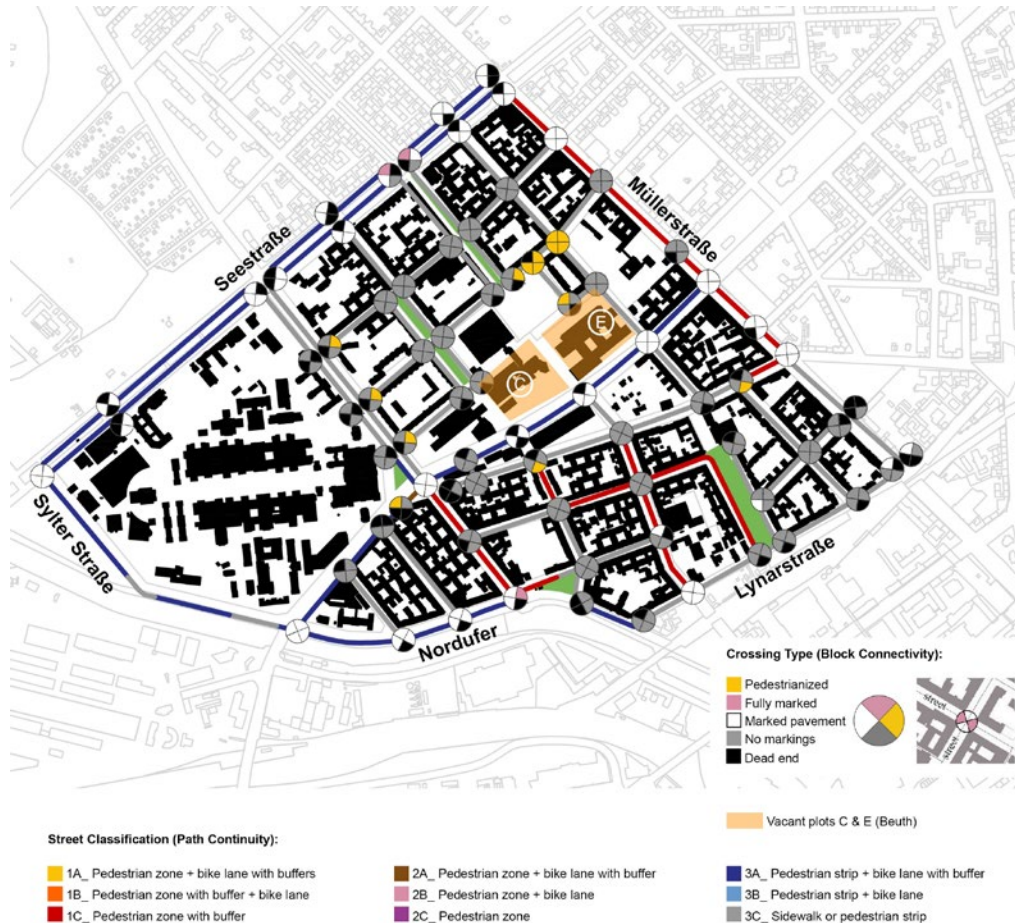


Figure 4. Meso Scale Conclusion Map



## Micro scale conclusions

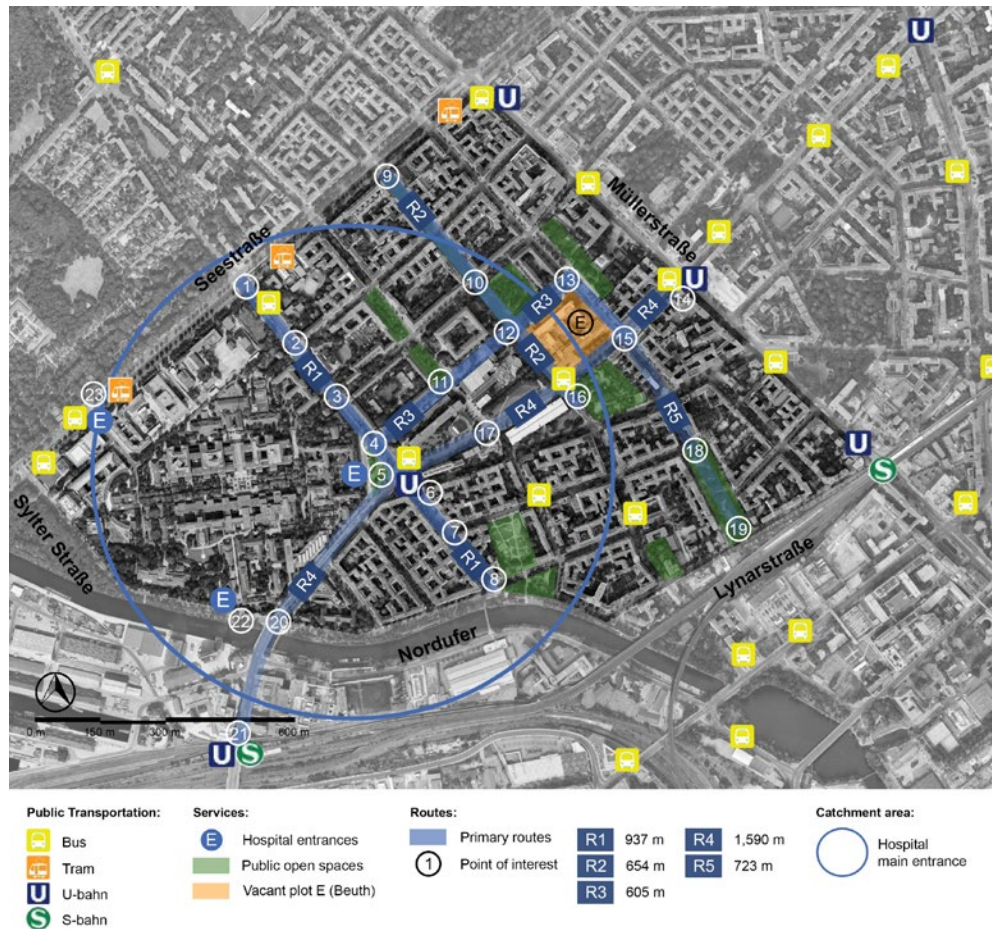


Figure 5. Micro Scale Conclusion Map

The micro scale surveys realized on the five routes (previously defined at meso level) identified 23 POI which environmental conditions require attention. The most relevant were those at public transportation hubs, street intersections, entrances to health-related destinations and most important the hospital entrance.

The hospital's main entrance has a very prominent space located at the border of both Kiez. At this point, the pedestrian flow is disconnected due to a broad intersection of three main collectors (Föhrer Straße, Amrumer Straße, and Luxemburger Straße) and car parking areas.

In general, all POIs provide universal access but not universal designs which could address children, for example. Half of these situations are not signalized but moreover they all need to improve pedestrian scale pathway finding. Sightline is not a problem across the whole study area only in a few situations close to green pockets (POI 16) where shrubbery does block views. Although spatial comfort at POIs are suitable in general, the evenly surfaced hard pavements can be combined with softer ones (more permeable) and more seating areas provided (respite areas), especially along Limburger Straße.

Noise levels during daytime and night time are moderate to low in all routes except for route 1 (see Figure 5) where at all times vehicular traffic is heavy on POIs 4, 5 and 6.

Natural light quality is not a problem, artificial lighting is. Along all street collectors, lighting at pedestrian scale is not provided, only for cars. In most local streets pedestrian lamps are present but need to be improved at some



street intersections as for example POI 11 where tree canopies are obstructive.

It is strongly recommended to develop a streetscape design concept for all 5 routes to improve their visual structure.

## General conclusion

This study found feasible to physically develop and implement a medical neighbourhood in the site studied. Medical teams can be built due to the proximity and diversity of medical solo-offices and patient journey quality experience can be easily ensured with moderate investments in streetscape designs. Although, despite a good provision of urban services and functions (compared to the Berlin average), it is highly recommended for competent research institutions in nutrition, physical activity, and social behaviour to realize further studies on the quality of service of the neighbourhood's environment.

These measures once adopted can address most of the common issues hindering sustainability in the German health care system by:

- decreasing high rates of lifestyle-related diseases with health promotion
- improving conditions for the elderly to age in place
- balancing costs for clinical care with community-level disease prevention measures
- enabling local staff for care and empower patients for self-care
- stimulating the creation of new health business partnerships among solo offices with the future PCMH
- creating a disease prevention and health promotion culture for other neighbourhood services to follow

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# Acting at a distance – prevention of mould or promotion of healthy housing

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## Abstract

*Housing and health have been subject for health policies for several decades. The subject is currently gaining attention from several disciplines and “healthy housing” is establishing as a field of multi-disciplinary research. One of the issues that concern both health and housing is the phenomenon of mould. As one of the sources of indoor air pollution, mould is associated with health risks such as respiratory symptoms, asthma, allergy and immunological reactions. The very microbial exposure and the health effects are complex matter, but so is the cause. Mould growth is the result of a time-dependent process including relative humidity, temperature and organic material; and each of the factors can both be caused by the building structure itself and/or the use of the building. Due to the uncertainties in quantifying the relation between conditions, exposure and effects it has been impossible to set definitive guideline values or thresholds for tolerable quantities. Consequently, emphasis is put on prevention: WHO address action by relevant stakeholders – including building owners, developers, users and occupants, but also the responsibility of public authorities to regulate and guide.*

*But is the issue communicated? Regulations, guidelines and information campaigns tend to focus on the negative health impacts and the prevention of hazards and risks. This knowledge often appertain a growing concern about the health risks, however, knowing the consequences doesn’t necessary result in a change of practice. As an alternative or addition to the preventive regulatory action is the promotion of health : encouraging well-being and setting the conditions for people to obtain and maintain a healthy home.*

*Various approaches are taken to solve or avoid the problem and this paper explores further how, in the Danish context, national regulations, health policy, guidelines and local initiatives manage to work with the problem in different ways.*

**Keywords:** Healthy housing, mould growth, classification, prevention, everyday practices

# Background

The paper is part of an ongoing PhD-project entitled 'Healthy Housing in a Sustainable Development'. Research positioned in the intersection of health and housing has long been predominated by the classical scientific approaches: In the field of indoor environment, an interdisciplinary approach has emerged, with microbiologists, health professionals and engineers working together (Gravesen, Nielsen, & Valbjørn, 2002). The mould issue have been approached from different fields of science and in the other Nordic countries related research programmes have been established addressing the problem in relation to allergy, methods of diagnosis and building construction (Pirinen, 2012; Boverket, 2010), and in recent years, there have been determined efforts from authorities and housing organisations in communicating the issue to the public (Becher, Øvrevik, Høie, Bakke, & Holøs, 2016; Folkehälseinstitutet, 2015; Folkhälsomyndigheten, 2014).

The main scope of the paper is to investigate the information and guidelines addressing the prevention of mould growth in housing in the Danish context. The historical outline illustrates the contexts and course of the contemporary conventions, where these practices of policies are located. The conventions play a pivotal role in co-constructing the contemporary understanding of the phenomena, through its classification of both problem and solution.

Due to the complexity of reality, the scientific understanding is often challenged when communicated outside these research environments. This article questions the role of the knowledge communicated in prevention efforts. Approaching the field from an ethnographic perspective and with the point of departure in the issue of mould growth, the overall objective of my study has been to understand this specific phenomenon in the context of everyday life and of everyday people.

# Methodological and theoretical approach

A desktop study have been conducted exploring documents, reports and articles, reading regulations, legislations and guidelines, concerning the historical trajectories from the early 20<sup>th</sup> century until today. The literature search included the archives of WHO's international websites, the Danish websites for architectural tradition [www.danskbyggeskik.dk](http://www.danskbyggeskik.dk) and the archives of the national health authorities. Through 'snowballing', these publications led me on to other materials, following their references and cross-references. Due to the fact that the Danish term for mould, 'skimmelsvamp', has changed in this course of time, the search also included the search words (in Danish) 'dampness', 'moisture' and 'microbial fungus'. Due to the pamphlets and guidelines, I have searched the different housing associations and the different relevant national organisations. The translations cited from Danish publications are my own.

Normally invisible to us, norms and conventions constructed in one scale are translated and have great impact in other scales. An analytical hierarchy of scale, that often is taken for granted and shape thoughts and practices at 'all scales'. Actor network theory (ANT) breaks with the working classification of scales, and see humans, substances and things working across these scales. Acting at a distance is in this context not referring to quantum mechanism, but concern the work of inscriptions. An inscription is a translation of someone's interest into material form (Callon, 1986). The translations are made to work in the network of actants, to intentionally affect/regulate/persuade/convince etc. The most effective inscriptions, the *immutabile mobiles* (Latour, 1986), are easily transported without change of inherent characteristics.

# Historical outline of the classification(s) of mould: as construction issue and as health risk

The phenomena we today know as mould, Microbial Fungi, has been part of nature's decomposition processes for billions of years and an actor of human's home environments, as long as we have built houses. Its presence and treatment is described in Leviticus by the term 'defiling moulds' and Vitruvius address considerations of climates to assure the healthiness of a dwelling:

*"In libraries with southern exposures the books are ruined by worms and dampness, because damp winds come up, which breed and nourish the worms, and destroy the books with mould, by spreading their damp breath over them."* (Morgan, 1914, p. 181)

Air change in dwellings and how to assure it, is also described in the textbook for house building (Gnudtzmann, 1888):

*"there are more or less valid theories of how to determine the scale of the air change needed to assure the health of individuals.... the most important thing is that the residents themselves realise the importance of obtaining fresh air supply; because, then this can always be provided, if one only allows the cold air."*

In the late nineteenth century, the discovery of bacteria and microorganisms and the effort to fight the epidemics of cholera and tuberculosis intensified the focus on public health. The controversies regarding this new status of health was also seen in the field of construction:

*'Regarding the hygienic disadvantages of accommodation in newly built houses, it prevails partly obscure, often exaggerated conceptions both among professionals and laymen. If the health hazard really was as big as frequently assumed, this would best be observed in the conditions of the larger cities, where the increase the last 20-30 years has been great both regarding the number of inhabitants and the number of buildings. If the accommodation in new buildings posed a health risk, it would be traceable as increased morbidity and mortality in the population during these great construction periods, where the new houses often are taken into use immediately after the craftsmen have left them.'* (Møller, 1901)

Healthy housing was part of constructing the welfare state, providing security and wellbeing to all citizens. A housing committee was established in 1916, taking over the authorities from the 'health police' to supervise the health of housing. At this time the link between microorganisms, indoor environments and health effects was somehow acknowledged, but it seems to fade in the course of the next couple of decades. During the industrialisation construction changes: the different disciplines specialise, new materials, new building techniques, new construction and new technical knowledge entering the scene. In this context, health was related to the increased comfort due to the new technologies:

*'Hygiene literally translated means health-theory and building hygiene is then the theory of the measures undertaken to make the building or dwelling useful and healthy for accommodating people'* (Ejlertsen, 1938).



The book on housing hygiene (ibid.) presents new technical aids as the toilet, basin and bath, as well as water-, gas-, lighting-, heating- and ventilation systems – which soon turned into the standard of new housing. Parallel to this progression and new standards, worn-out housing areas were classified as unhealthy and slum clearance requested. However, in this context the mould was not yet an issue. The professionals of construction were most concerned with its wood-digesting relatives, and in microbiology and medicine professionals were busy celebrating the discovery of the *Penicillium chrysogenum* and its capacities as antibiotics.

Nevertheless, during the sixties, reports on allergic reactions due to damp buildings kept increasing. In the seventies, research in occupational allergic issues, related some of these allergic symptoms to microfungi in the indoor environment (Gravesen, 1979). Reports of building related symptoms where identification of the actual cause showed to be problematic, made the basis for diagnosis such as *the sick-building syndrome* (SBS), where mould was considered one of several causes.

These findings were addressed in a European initiative - The European Collaborative Action ECA "Indoor Air Quality & Its Impact on Man" operating from 1988 -2007. In this work Danish researchers were also represented, including a researcher from the Danish Building research Institute who co-authored the 4<sup>th</sup> report on SBS (ECA, 1989). Further, a Danish pharmacologist co-authored report no.12 on biological particles (ECA, 1993), including a review of the contemporary research on microbial fungi, counting existing sampling methods and models for analysis, and recommendations for future studies. This pharmacologist later joined the institute for building research where a larger research programme on mould in buildings was established. Parallel to this national and regional effort, WHO have been working globally, where especially the 'health for all' policy framework initiated in 1980, has supported the still ongoing work on establishing scientific consensus, policies and guidelines.

## Diagnosing

The work of classifications and consensus-building is an open-ended process. In science, new research challenge existing models and understandings, nevertheless the scientific knowledge is almost by rule mediated as the 'truth'. As de-contextualised representations, the scientific inscriptions are considered matters of fact. These matters of fact are employed when assessing and diagnosing the cases of the everyday.

However, the practice of diagnosing is a complex process. If we start with the symptoms these are multiple, and can have multiple causes. Presence of mould in the indoor environment have since the 70'ies been related to a range of respiratory health issues, from asthma and allergy, allergic rhinitis to headaches, fatigue and vertigo. The reaction varies from immediate to hours delayed. It can be triggered by several other allergens than mould: In our indoor environment, in food, or even in the great outdoors. When a patient addresses his/her physician with asthma and allergy, their indoor environment and mould-problems is only one of the parameters when screening for possible allergens. Consequently, identifying the underlying cause in such a diagnostic process requires an active, responsive physician and a close dialogue. **Second**, people's response to allergens are by large diverse. In a household a mould problem can cause severe challenges for one individual and none for the other. Generally, children are more sensitive to allergens than grown-ups as their immune system is still developing. Old, pregnant or individuals with a weakened immune system are less tolerant to the allergens. Nevertheless, healthy people can also experience severe im-

pact on their well-being and eventually develop sensitivity or allergy. A blood sample or a skin prick test can show if the patient is allergic to a given mould species, but one can even get harsh symptoms being allergic so the diagnosis is tricky. Third, up until recently one have assumed that different species had different effects, where the mycotoxins produced by *Aspergillus*, *Penicillium* and *Stachybotrys* made them the 'bad species'. This somehow acquitted the other species as less toxic. However, recent studies casts doubt on this, and perhaps none of the species can be acquitted. **Fourth**, the diagnostics of the suspect substance is also problematic. Despite of different methods for sampling and analysing on the market, there are no official national or international standards. Methods are changing due to new technologies, market demands and scientific research, and the different players on the market drive the innovation. The different methods produce different results which can be a challenge to interpret. **Fifth**, the practices of removal and remediation are also diverse and the scenario of mould, 'hidden' inside the construction, under the floors or inside a stud wall construction, challenges the classifications: Is it still part of the indoor environment and a health risk to the occupants? Recent studies have shown that drying mould, which earlier have been considered less affective, on the contrary is more hazardous. **Sixth** and adding to the complexity is the multiple causes that can be triggering the mould. Due to the question of risk and responsibility this is perhaps where the deadlocks most often occur. Damp conditions can be caused both by constructional issues and inadequate use of the building - most often it is a combination, but sometimes the question of responsibility turns into a dispute. Controversies of who to blame are for example seen regarding housing sales or in rented housing, where the responsibility for maintaining the building is shared. In this setting the causal diagnosis of either the occupant or the house is also used to place the obligation to fix the damage.

The diagnostic dilemma is illustrated in the case of SBS where the practice of diagnosing is conducted on an individual level opposed to the definition where the diagnosis concern a system level (the individual(s) *and* their environment) (Thörn, 1998):

*"...considers SBS as something that afflicts the building and has the potential to cause disease, while in the former case it seems to consider it as the expression of an individual disease. These two different views probably reflect the fact that the SBS definition is dualistic, containing both outcome (symptoms) and exposure (building)."*

Essential for any translation process, is the interpretation and simplification. The translation will always be influenced by the translator's specific interests.

## Practices of prevention I: policies and guidelines

Answers to the question 'why it is so hard to prevent mould growth in our buildings?' have shown to be multiple (Øien, Submitted a): Multiple causes and multiple interpretations, and the multiple efforts to control or prevent it. When the mould gets classified as a health risk, an arsenal of regulations take effect: Laws regarding health risks in dwellings include the Social Housing Act, the Urban Renewal Act, the Building Act and the Rent Act. These regulations don't address the mould directly, but through its classification the field regulated is extended. Based on these extended regulations, authorities as the Health Authority and the Working Environment Authority draft guidelines and plans of action for managing the future situations.

In 1996 the Health Authorities closes the department originally working with health risks. Then again, the following year the Danish Building Research

Institute initiated a concentrated and cross-disciplinary effort in the field (Ingeniøren, 1997).

In 2003 the government presents a strategy to protect the health of the population against environmental factors (Regeringen, 2003). Included in their ten goals was a) to reduce the negative health impacts of pollution in outdoor air and indoor air and b) to reduce the incidences of allergy and respiratory diseases.

The strategy presents a 'coherent and increased' authoritative effort to inform the public on how to improve indoor air quality in homes. Including information concerning building construction, building operation, maintenance, ventilation and cleaning. In order to 'prevent adverse effects on health from the indoor environment' the strategy calls for a mobilisation of research: to better understand how and to what extent the various environmental factors in the indoor environment affects us'. The overall objective was to ensure good indoor air quality and minimising the health risks - of 'discomfort, diseases and symptoms' (ibid.).

The initiative also launched a coordinated working group to ensure a coherent effort from the authorities. The objective of the working group was among others to improve the collaboration regarding preparation of guidelines and other initiatives, comprising *quality-demands* and *threshold values*. The existing knowledge in this area should increasingly benefit the population through increased communication and consultancy.

The following years was accompanied by an extensive political action on the mould issue; initiatives from the Ministry of Economic and Business Affairs, the Ministry of Welfare, the enterprise and construction authorities and the health authorities. Proposals for an building damage insurance, tightening of the building regulations by documentation-requirements of moisture conditions in the building permit application (Økonomi- og erhvervsministeriet, 2007), procedures for handling the mould issues for respectively the municipalities (Velfærdsministeriet; Erhvervs- og byggestyrelsen, 2008) and the private landlords (Velfærdsministeriet, 2008). Additionally, information material about mould for tenants in social- or private rented housing were translated into four foreign languages.

## Situated in everyday life

The political and scientific efforts can be seen as different ways of controlling, managing or preventing the mould issue. The phenomenon is translated into different means or inscriptions and guidelines for keeping it absent – especially concerning the regulation and guidelines for the building design. But the political efforts also address practices of how to prevent and manage the phenomenon if it occurs, divided among different areas of responsibility, such as the municipality, the house owner and the tenant. In rented housing the everyday use and maintenance is often shared by several, typically the interior being the tenants' responsibility and the exterior the building owners' or the housing associations' responsibility. The next paragraph illustrates some of the information material that is part of preventing the mould issue. The inscriptions are used to articulate a concern, in order to get the concerned to take responsibility.

### Practices of prevention II: The Information pamphlets

The scientific knowledge is communicated to occupants and staff operating the buildings through information material. First of all, as guidelines of how to prevent the actual mould problems and second, informing about the substance and its health effects. The pamphlets have mainly been produced by the social housing organisations or the National Building Fund for distribution to the occupants, and often part of the information handed over when moving in.

A pamphlet, designed for the superintendents and caretakers (Valbjørn & Clasen, 2002) list both constructional concerns and the importance of instructing the occupants. The guidance is overall action-oriented, as it describes procedures for inspecting, maintaining and repairing constructional damage caused by damp or mould. The last page stress that mould can cause disease and damage to both occupants and building. However, the constructional concerns represent 80 % of the bullets presented, and the title of the pamphlet 'Avoid damp and mould damaging the *property*' illustrates the underlying emphasis on the building as such.

Both the material for the occupants and the material addressing the caretakers are largely prescriptive and 'calling for action'. In one of the pamphlets for tenants (Landsbyggefonden, 2008) four of the five recommendations are instructions on what to do: 'air out', 'do not dry clothing inside', 'use exhaust fan' and 'keep lookout'. Likewise the five steps for removing the mould are action-oriented: 'check the residence', 'remove the cause', 'clean the mouldy area', 'check...' and 'contact the maintenance staff...' Everything but the last step addresses the occupant and his/her opportunity for action. This information 'postcard' is translated into seven languages for handout to the tenants. It doesn't really say much about the mould as such, except referring to a website where the phenomenon is explained quite thoroughly, including the multiple causes and the potential health issues. Information material from the same campaign, but addressing the janitors is much more comprehensive. This brochure recommends early intervention, based on a common interest for both building and occupants, and call for dialogue and collaboration.

The damage- or disease prevention communicated pass on these underlying cultural attitudes. As inscriptions translating a message: *the mould is dangerous*, to encourage certain behaviour. In this translation, the responsibility is largely put on the individual, who is expected to take this obligation. The matter of fact mediated – *the mould is a health risk* – turns into a matter of concern.

## Re-contextualised

These campaigns and information pamphlets may seem simple and straightforward, but looking at the mould problem, it doesn't seem to have had the convincing effect. As stated in a technical building instruction already 70 years ago about the overall problem of dampness in buildings:

*'Just twenty years ago one was unsecure about the problems, but today we know it so well that the problems of dampness in standard construction should be eliminated ... The understanding of most of the phenomena is due to the simple fact that water humidity is finding the coldest spot. ' (Becker & Korsgaard, 1957)*

The janitor manages several buildings and even more residents and meets all kinds of people, both those taking good care of their apartment and those less good at it. The buildings might be just as unpredictable and different, and the colleagues of janitors are themselves unique individuals, develops customised practices for the different scenarios (Øien, Submitted b). The team of janitors, for each department varying from a single part-time position to a staff of several, practices the day- to-day operation and maintenance of the buildings. In rented housing the people living in the units do not own them themselves, which encompass another layer of relationality with multiple interests at stake: Sometimes causing problems due to questions of responsibility and maintenance, both concerning landlords not maintaining the building structure and tenants misusing the interior of the tenancy. For private housing the insurance industry frequently deal with disputes between residents and landlords, buyers and sellers of dwellings. The field of insurance practice the construction technical classifications, where the mould in deed has shown to be hard to classify. Not posing a direct risk for construction as its cousin dry rot and other wood-decaying fungus, it has traditionally not been covered by the insurance.

On the other side, the tenants are of course most concerned with their own health, and the mould issue is diagnosed and communicated on an individual level. And by the classification as a health risk it makes it a potential concern to all. Due to its microscopic scale the mould primarily exists as an abstract and inaccessible conception or a suspect if one experiences allergic symptoms (Øien & Frandsen, 2015). It seems as if each of the professional stands considers the problem to be (theoretically) manageable, but in practice it turns out that most variables, however neatly classified, doesn't fit in real life. As part of everyday life and practices, the regulations and guidelines are re-contextualised. In real life these inscriptions are weighed against all other possible norms, guidelines, routines, more or less scientifically proofed. In the case of the occupant, his or her everyday practices concerns economical, practical, social, political and cultural considerations: saving energy, money, time, space or effort; then it may well be no use to open the window? Or it might be the best or the only solution to hang-dry the laundry in the living room or the bedroom. The hood might be too noisy to use or even too ugly to install. An information pamphlet encouraging you to open the window, merge with your cultural background and upbringing, but is also situated in the context of household technologies.



Figure 1. Excerpt from a pamphlet from the fifties, instruction of how to avoid dampness (SBI, 1954).

Figure 1 shows an excerpt from an information campaign from the fifties (SBI, 1954): By large the same message as the pamphlets seen seventy years later, however the contemporary household is a complex hybrid of all different technologies, that easily question the practices of fx opening the window.

The context of our hybrid contemporaries as consumption-, risk- and information-society makes it all diffuse. Challenges of maintaining a healthy indoor environment and keeping the mould out is a more complex act than first assumed by the different schools of thought - and mould is definitely not caused by the occupants' bad habits alone.

Latour (2004) describes matters of facts as being naturalised and objectified by science, only partial, polemical and political renderings of matters of concern. The mould resists being treated as a matter of fact, or put in another way; these *different* facts, indeed makes it a matter of concern.

## Adding promotion to the toolbox

The complexity of the mould issue holds parallels to another contemporary subject, regarding lifestyle diseases. Lifestyle diseases have shown to be hard to classify as the complex patterns of disease holds many interacting parameters, including lifestyle and environment. This also makes the treatment a challenge. The information campaigns addressing the health risks of this group of diseases have not gained the desired effects. As a consequence, and contrary to the classical notion of disease-treatment, a huge effort is put on prevention strategies aiming at reducing these risks. However, the strategies and the understanding of a specific problem are determined by the available options (Jöhncke, et al., 2004). The possible solutions anticipate what is possible and what's worth knowing about the problem. The process of framing the problem reflects certain social rationalities, the norms and conventions of the specific culture or society. As with mould, the lifestyle diseases have been framed as different problems with different solutions.

Kristensen (2004) explains the failure with the fact that people do not live as risk- and calculating individuals, and everyday decisions are not based on statistical evidence and security, as the professional understanding is. The professional and the experience- oriented perspectives represent two very different approaches to health and/or disease: as the risks of death or the possibilities of life. The campaigns have traditionally substantiated the *individualistic responsibility* for a healthy living using the motif of mortality. The notion of the individual in "Blaming the victim" has been problematic (Jensen, 2004), at worst, the citizen gets disempowered: 'dismantling the individual's existential responsibility, choice and convenience' (Kristensen,

2004). And in case of the mould issue the individual responsibilities have been manifold as they concern and strike both the human and the building.

The Ottawa Charter (WHO 1986), define health promotion as "*... the process of enabling people to gain control over, and improve, their health ... an individual or group must be able to identify and to realize aspirations, to satisfy needs and to change or cope with the environment*". But in the prevention attempts the information remains *information* and is only to a limited extent acquired as knowledge. Transforming the information into knowledge and the knowledge into knowhow requires an active involvement of the individual (Kristensen, 2004).

# Discussion

The historical outline shows that mould has played different roles in different practices and that the classification as a health risk has changed its status dramatically. From being a sign of the ravages of time and an indicator for maintenance, to being the less 'dangerous' sibling of the wood decaying fungus, the transition to becoming an invisible, ever present health risk, represents different versions of the socially constructed phenomena. Despite the great political and scientific effort, the problem of mould is still by large perceived as a wicked problem. Head of the Danish Health Authorities at the time, commented on the problematic mould issue related to managing mould problems in one of the many social housing departments from the 60'ies (Ingeniøren, 1996):

*"If experiments are to be made, it must be in accordance with the correct scientific premises..."*

This 'correct scientific premise' has indeed been problematic as the different scientific schools of thought have had difficulties reaching a common understanding and still are affecting both professionals and laymen's practices of everyday life. The information and guidelines communicates the underlying scientific understanding, either representing the construction- or the health perspective. The multiplicity is pin-pointed in an article about housing insurance. A defect-insurance will compensate if damp or mould made the real estate uninhabitable, however:

*"... In these situations one consider whether the occupant get sick of living in the house, but the disease can be due to many things, and need to be assessed by doctors, microbiologists, building technicians and a lot of experts who do not at all agree, and it has nothing to do with building insurance..."* (Ingeniøren, 2009)

In 2008 a workshop concerning the need for health counselling regarding the mould issue in housing environments, emphasised the challenges of quality-demands and threshold values (Center for forebyggelse, 2008). The workshop underlined a need for interdisciplinary collaboration, however held on to the argument that the building experts and technicians should focus on the buildings and the physicians focused on the guidance and treatment of patients. In the recommendation for health professionals (Sundhedsstyrelsen, 2009) the challenges of threshold values, is addressed as both due to species, concentration and extent of the mould.

Research in health prevention and promotion have recognised the different types of knowledge of everyday practices, and acknowledged the diverse ontological perspectives at play. A Health Authority Centre for Prevention has drafted a common terminology across different disciplines (Center for Forebyggelse, 2005). This work is based on an understanding that the terms in use are socially constructed and ever changing, emphasising the interdisciplinary and the inter-sectorial characteristics of Public Health. The terminology is targeted at the health authorities and thereby only partly the housing environment, however the mould issue call for a similar exercise of coordination, perhaps even more transverse, even inter-transverse, also including the professions of architects and planners.

The Health Authorities recently addressed the mould issue in schools in a handbook for Health Service in Schools (Poulsen, 2015). The handbook is



part of a 'prevention package' among ten other launched in 2012, and address a wide approach coordinating the municipal policy, action plans of the local schools and education, involvement and management of the individual teachers and pupils. This coordination includes a translation of knowledge between the different organisational levels. Support, is a key concept, both in supporting the effort of practices of everyday routines and the division of responsibilities relating to the indoor environment, but also in the layout of the school supporting the good indoor environment.

## Concluding remarks

The preventive approach to the mould issue has somehow been short-sighted, acknowledging and withholding the problem; because the very issue of mould is a symptom of a range of other underlying problems. Ideally, acting at a distance should start from a relational understanding of the house as a technology or a system comprising the building, its users and the context where it's situated. And the approach made regarding the schools is one way of doing this.

Like statistics or quantitative measure in a research environment, the classifications produce immutable mobiles, but in the 'real world' these are challenged. First of all, reality is always in motion, it changes and transforms. Second, real life is always situated, relating to a time and place. Third, reality is filled with all kinds of classifications and classification systems, not necessarily in accordance with each other. Fourth, realities are populated with humans, things and other beings, all unpredictable and indeed mutually interdependent. The mould, made to be a scientific matter of fact, is in 'the real world', in the everyday life, a matter of concern.

Still, the different classifications and understandings of mould hold a huge impact on the practices of the everyday. In this 'acting at a distance' both the problem and the solutions to the problem, including the prevention of it, is affected by the positioning in norms and conventions. Hastrup (Hastrup, 2004) suggests for the strategies of prevention not to define the problems at stake by what's possible, nor on the other hand try to define sickness and health as representations, but to consider the complementary, relational dimension between the different scientific schools of thought.

Prevention of mould should apply a cooperative approach, as it takes continuous effort, through the lifespan of a building. In this, promotion, support, prevention, regulation and treatment can be seen as different tools, representing different temporalities and scales.

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# Light, Air and Natural Surroundings – in Different Hospital Typologies

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Figure 1. The paper is based on literature, architectural drawings and photographs, together with on site registrations of plan, height and orientation as here on the roof of The State Hospital

# Abstract

*During the past century medicine and healthcare has changed dramatically and along with these, hospital architecture has changed too. This paper focus on the historical affinity between the three basic elements; light, air and natural surroundings. The paper analyses how these elements change and how these changes affect the planning of hospital care units over time.*

*Based on six different case studies, the paper draws an outline of the challenges in hospital architecture up through the 20<sup>th</sup> century and puts knowledge about light, air and natural surroundings in a broader perspective in order to utilize it better in the planning of architecture today and relate it to the challenges hospitals are facing today.*

*The first case study serves as a historical baseline reference, it is a monastery.*

*In the transition years between Catholicism and Protestantism in the 16<sup>th</sup> century, monasteries served as public hospitals for poor people, providing easy access to light, air, natural surroundings. The second case study is the pavilion hospital, based on the expansion of The Hôtel Dieu Hospital in Paris. In the late 19<sup>th</sup> century, especially light and air finds a scientific position in the planning of hospital architecture. A role that peaks in the third case study; in Modernist movement of the 1930s, in the interwar period, where light, air and natural surroundings are planned carefully in hospitals, sanatoriums and schools. However, the medical development in the post war period, and mass-production of vaccines and antibiotics ends this era and the affinity between light, air and natural surroundings. The fourth case study documents a block hospital architecture, planned without any fear of infectious diseases. This changes the footprint of the hospital, the ceiling height, the depth of building, form of ventilation, and light quality. After describing the street hospital, the paper sums up contemporary architecture in the sixth case study; a base hospital in England, discussing what is won and what is lost in this development, without taking any party, the paper relates old knowledge to new knowledge in order to improve the atmosphere in the future hospital care units and the built environment.*

*Keywords: Health, Architecture, Healing environment, Light, Ventilation, Natural surroundings.*

# Introduction

This paper focuses on the elements; *light, air* and *natural surroundings* and analyzes how these three, healing elements are planned, how they change and how this affects the planning of hospital design over time. In recent years, several publications have been published<sup>i</sup> dealing with these elements and their impact on health at hospitals<sup>ii</sup>. However, the main part of these publications focus on singular cases, over a short span of time, often focusing on one singular element such as *light or air or natural surroundings*. This paper differs from these publications by comparing cases from different periods and studying the interrelation between light, air and natural surroundings, using the different building typologies as a framework of reference.

Today, strict energy requirements set the agenda when it comes to the planning of a hospital<sup>iii</sup>. Light and ventilation are decisive elements in strict calculations focusing on the general energy consumption<sup>iv</sup>. The aim of this paper is to put this agenda into a broader perspective, also addressing health related and historical aspects of these elements. Through a comparative study of six different hospitals and their different building design, the paper reveals different golden practices when it comes to the relation between light, air and natural surroundings. Describing the different building typologies, from typologies primarily based on health requirements to typologies primarily based on energy requirements.

The typologies represented are; *the pavilion hospital, the corridor hospital, the block hospital, the technological hospital, the street hospital* and *the base hospital*.<sup>v</sup>

The term *corridor hospital* is new and a short definition may be appropriate: In the continuous development from pavilion hospital to block hospital, many factors were involved, but with the general appearance of elevators, taller and larger versions of the pavilion hospital emerged during the interwar period 1930 – 1945. These new hospitals, characterized by larger, deeper and longer building designs, meant less natural ventilation, less daylight and long, undivided corridors, giving name to this typology.

# Methology

Methodically, the paper is a *retrospective comparative case study*<sup>vi</sup>. The search strategy is based on *mixed method research*<sup>vii</sup> with source material ranging from qualitative descriptions of buildings, including on site measures of plan, orientation, site and surroundings, to quantitative descriptions, based on historical data and literature, including a literature search on the words *daylight*, *air* and *natural surroundings*. This mixed method approach is rated to cover the complex area more adequate than any quantitative method or specific comparison over time during the period of a hundred years.

Selection criteria for the comparative case studies are: 1) year of inauguration (chronologically divided into five intervals) 2) typical archetype (a contemporary building design representing each period). The paper is composed of six comparative case studies, presented in chronological order, each case representing a typical hospital architecture of their time, built with 20 years interval, spanning the period 1910 – 2010. As far as possible, the paper creates a comparable structure between the different typologies, creating a frame of reference describing the historical context, strategies for daylight, strategies for ventilation and strategies for natural surroundings.

The paper raises the following research questions: How is light, air and natural surroundings planned in the period 1910 - 2010? How does this planning change during the period and how does it affect the hospital architecture? Can we learn from past best practices when planning and describing a healing environment at hospitals today? By addressing the historical changes in light, air and natural surroundings, the paper contributes with historical aspects of the relationship between light, air and natural surroundings, relating present to past practice for a better understanding of both.

The hypothesis is that the planning of light, air and natural surroundings has changed dramatically during the period 1910 – 2010, from being planned as one entity, integrated in the building design, to being reduced into three independent, measurable elements; light separated from air, air and light separated from natural surroundings. Each element simply added to the building, instead of being an integrated part of the buildings physical design. As a derivative result of this, the energy consumption for light and air has increased over the period.



# Sites

The Bispebjerg Hospital (1913), Aarhus Municipal Hospital (1931), Glostrup Hospital (1958), The State Hospital (1970), Skejby Hospital (1987), Birmingham New Hospital (2010)

# Conclusion

The overall conclusion of the paper is that the planning of light, air and natural surroundings has changed dramatically during the period 1910 - 2010. From being entirely based on natural daylight and natural ventilation (1913) to heteronomy of daylight and artificial lighting and autonomy of mechanical ventilation (2010).

Originally, the planning of light and air was driven by health-based requirements, but over time, this planning increasingly becomes driven by energy-based requirements during the period 1910 - 2010. Paradoxically, at the same time the energy consumption and the degree of mechanization increase through the period.

The building design also changes, from small, slender buildings to larger and deeper buildings with lower ceiling heights. The earlier recommended ceiling height of 4.2 m is gradually lowered to 2.7 m through the period – introducing lower, horizontal windows, providing less natural ventilation than the earlier tall windows, originally optimized for natural ventilation.

Originally, the elements light, air and natural surroundings were closely linked together. However, the relationship changes fundamentally over the period. From being planned as a trinity of interrelated elements, light, air and natural surroundings increasingly are planned as singular elements, separated from each other and separated from the building design.

This paper confirms a close relationship between light, air and natural surroundings, and suggests that separating the three elements from each other in the planning of a building design poses a real problem. Instead, the paper suggests planning a healing environment as a trinity of these elements integrated in the building design. There is a latent risk of overlooking this unity when reducing it into singular, independent elements, spending too much energy on one detail or singular element, with too little focus on their totality and their joined effect on each other, and on the healing environment.

Through examples, the study shows that a one sided focus on one singular element, e.g. mechanical ventilation and high air change per hour, actually compromises the planning of light and natural surroundings. The study shows that the energy consumption to mechanical ventilation has increased and suggests it can be supplemented by natural ventilation, in order to introduce better daylight quality and improve the healing environment as such, at the same time reducing the energy costs. The same applies when it comes to a one sided focus on light, which again compromises other functions of a window, such as the air-intake and its capacity to kill bacteria. Finally, a one sided focus on panoramic views and natural surroundings compromises the planning of good daylight quality and thermal comfort, which again compromises the ventilation, etc.

A lot of knowledge and rationales for common practice have been forgotten when it comes to planning of light, air and natural surroundings. However, more work needs to be done in this cross-disciplinary field, reestablishing the building physique and improving the concept of a healing environment as a complex unit of multiple, coherent factors in the building design.

## Case Studies – From Monasteries to Modern Hospitals

Hospitals are known a long time back in history to the hometown of the medical god Asklepios from Epidaurus in the Ancient Greece, 6th century BC. The word *hospital* originates from the Latin *Hospitium*<sup>viii</sup>, meaning a guest-house or shelter for the needy. However, in Denmark, the first hospitals are not built as hospitals, but as local monasteries, helping the sick. Alling Monastery, originally built by the Benedictine Order in 1250 is an example of such an early hospital typology. The monastery is laid out following a strict typology, with dormitories facing east, like the church choir, and the kitchen facing north. The atrium in the center is built as a garden with a well and a roofed patio around it sheltering from rain and wind. The zoned building areas based on daylight and natural ventilation, make the monastery typology very energy effective. The thermal differences in temperature and humidity between atrium and outside create different air pressure, cooling the building during summer and sheltering humans and herbs during winter. Elements such as daylight, air and natural surroundings are integrated in the building design. A slender building shape, with small, openable windows providing access to daylight, and natural air, and the atrium at the same time providing direct access to natural surroundings. No standards for light, air or natural surroundings are ever applied for this typology. However, a long tradition<sup>ix</sup> of making the most of the sunlight and natural (cross)ventilation, balancing light and heat from the winter sun and the summer sun, are fundamental, architectural principles in this typology.

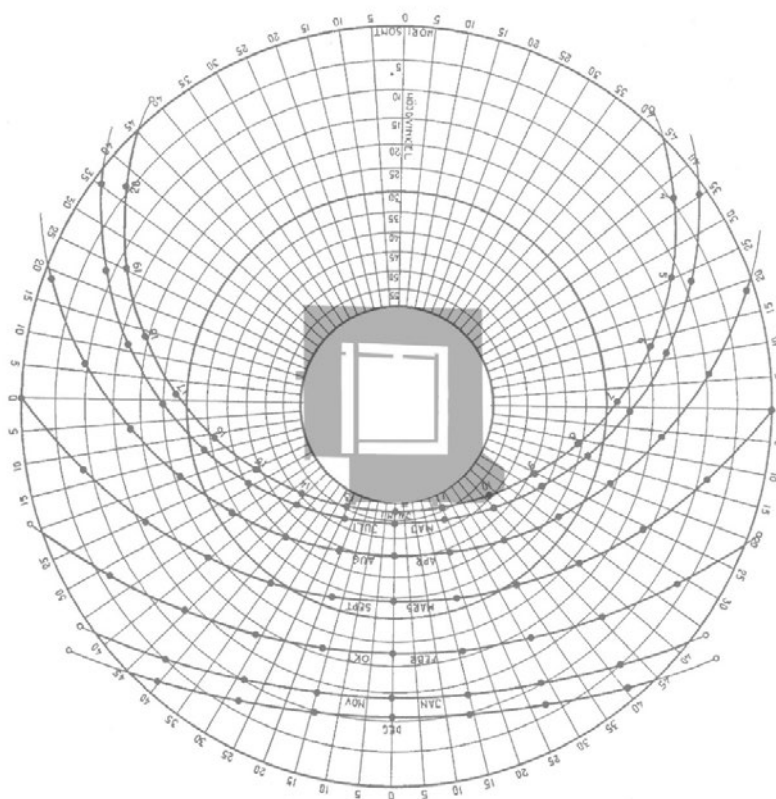


Figure 2. Alling Monastery 1250

The Reformation in 1536 ends the authorization of these Catholic monasteries and their right to provide medical assistance to the sick and poor people. The monasteries are replaced by, more or less randomly built, hospital buildings, serving as *residences for poor, sick people and arm, miserable, fatherless children for maintaining cloth, food, necessities, help, consolation and life support*.<sup>x</sup> These new hospital buildings initially are financed without any state aid, entirely based on private donations. At this point, they do not constitute any specific hospital function but rather a variety of functions, depending on the wishes and means of the patron. From the so-called *Vajsenhuse*, serving as a kind of orphanages for poor, dependent children to sick homes for the elderly.

The first ever publicly supported hospital in Denmark is The Frederik's Hospital, built in 1757. Later, following a cholera epidemic in 1853, other new hospitals emerge, outside the ramparts of Copenhagen, such as The Municipal Hospital in 1865. In many ways, these new hospitals define a new and a healthy era for the architecture. An era where light, air and natural surroundings become important healing elements in architecture; the first of these is the pavilion hospital.

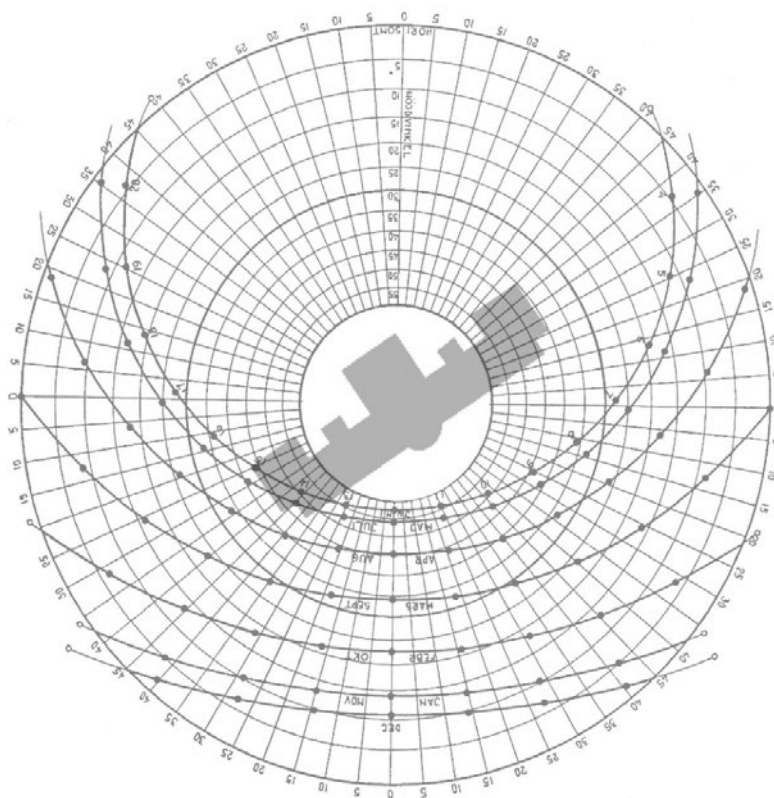


Figure 3. Bispebjerg Hospital 1913

## The Pavilion Hospital

Bispebjerg Hospital, inaugurated in 1913, is built in a rural location north of Copenhagen, with access to light, air and natural surroundings high on a hill. The hospital covers a total area of 193,000 m<sup>2</sup> (35 acres). The hospital initially accommodates about 700 patients and the average length of stay is 35 days. The architect, Martin Nyrop, originally is inspired by the local climate.

*Not the least in our climate, with relatively little sun, it is of importance to place hospital buildings in such a manner that the living rooms for the sick deliver the best access to fresh air and sunlight<sup>xi</sup>*

When the patients become healthy enough, they exercise outside in the flowery gardens on specially designed terraced walking paths. The hospital is built around a symmetrical axis, with new pavilions eventually emerging over time. All the buildings at Bispebjerg Hospital are small, scattered pavilions, planned to optimize the elements sunlight and air, in order to avoid infections. Originally, this typology stems from the expansion of The Hôtel Dieu in Paris. However, the typology later is further improved by Florence Nightingale, and her pioneering work on evidence-based design at field hospitals during the Crimean War, 1853-56. Here, she observes how mortality among the wounded soldiers depends on the orientation relative to the sunlight. In particular, she highlights the great impact of the winter sun on patient survival and recovery and the major importance of the natural surroundings.

*What nursing aims to do (...) is to put the patient in the best condition for nature to work upon him<sup>xii</sup>*

The so-called Nightingale Wards are oriented towards the winter sun, facing S and SE. They are laid out in a grid, following a simple principle; twice the distance of the buildings total height<sup>xiii</sup>. In this way, the hospital architecture enables sunlight through all seasons. The major outside areas, exposed between the buildings, serving as important architectural elements, providing natural surroundings, with instructions for their specific use and nature.

*The surroundings may not be tiled and surrounded by dense, tall buildings, but instead appear as open, cultivated garden landscapes with the possibility of pavilions, shelters, etc. so that patients, regardless of the weather, may reside outdoors<sup>xiv</sup>*

Besides the pavilion typology – which in itself optimizes light and air – the Nordic style with all its nooks and sunrooms contributes with larger facades, increasing the number of hours of sunshine and the possibilities for natural ventilation. At this time, in the early 20th century, open balconies and direct access to gardens in general are considered beneficial for the health<sup>xv</sup>.

When it comes to fresh air in the indoor environment, recommendations of 70 m<sup>3</sup> of air per patient per hour is a golden standard, corresponding to approximately 2,500 cubic feet per patient per hour<sup>xvi</sup>. This partly is achieved through increased recommended ceiling heights of 4.2 m (14 feet) corresponding to approximately 2.5 times the depth of the building. Here, natural ventilation and direct UV-rayed, sunlit air supply through the tall sash-windows<sup>xvii</sup> are crucial elements, based on Niels Finsen's pioneering work on the health beneficial effects of sunlight and UV-light<sup>xviii</sup>.

Although the increased ceiling height and the tall windows simultaneously create more daylight and more ventilation, it is not enough to ensure the minimum supply of air on the large wards with up to 28 to 32 patients. Natural ventilation, through so-called *louvred shafts* located a distance away from the buildings, provides an efficient additional ventilation system, making it possible to achieve the recommended minimum supply of air. These louvred shafts provide fresh air through an ingenious system of air ducts, leading from the floor level to the top level, held off the ground to avoid moisture. The air is passing hot water heaters and after heated to approximately 19 °C, the air is fed into the wards through ventilation grates mounted about 1.6 m above floor level. The now heated, fresh air rises and ventilates the entire room, gradually mixing with the cold air. Spent air is vented out through grates, placed at floor level, under each bed. The system ensures

an even temperature with fresh air across seasons, supplemented by strict rules for openable windows.

*Windows are made to open (...) Always air from the air without, and that, too, through those windows, through which the air comes freshest<sup>xix</sup>*

Overall the Bispebjerg Hospital is built following every applicable principle and golden standard of healing architecture today. However, the hospital's major problem is too large distances, caused by the strict requirements for a minimum distance to provide sunlight and natural surroundings. Gradually, this typology is replaced by larger, taller and more compact buildings, with lower ceiling heights and less strict demands to sunlight, air and natural surroundings.

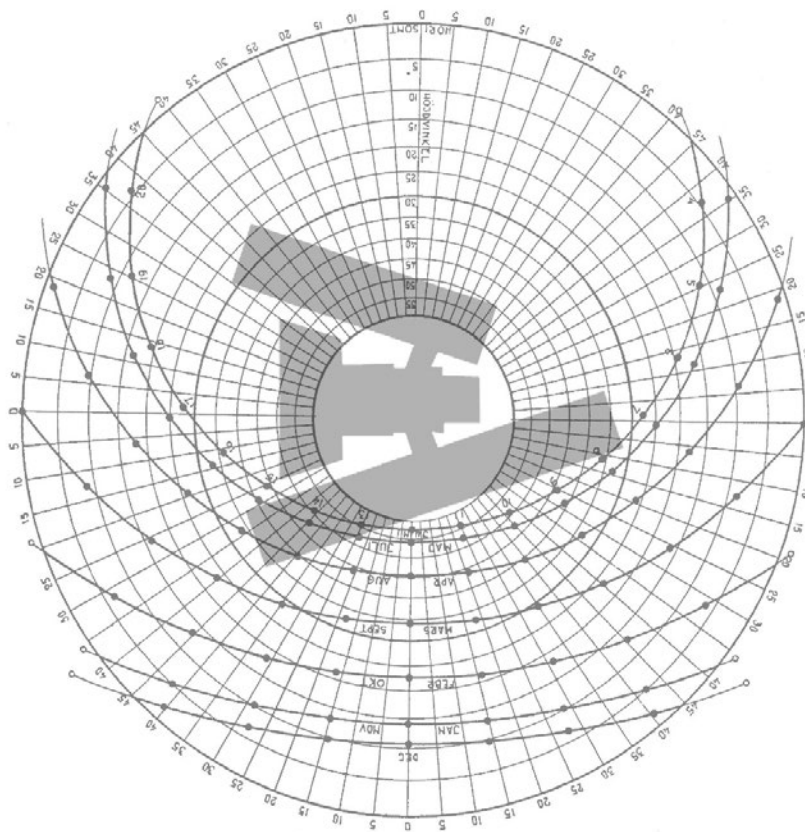


Figure 4. Aarhus Municipal Hospital 1931. The facades are facing SE (bottom), however later during the construction period this orientation is abandoned (top)

## The Corridor Hospital

Aarhus Municipal Hospital, built in 1931 is placed outside the city, expanding an existing pavilion hospital built in 1893. Like the Bispebjerg Hospital, Aarhus Municipal Hospital is built upon a hillside, with wards facing SE. The first buildings are inaugurated in 1935, and several other buildings follow through the period up until 1959, including the main eight-floor building, finished in 1943.

As hospitals grow in size, so does the need to minimize the distances and this affects the architecture fundamentally. The earlier recommended three floor levels gradually increase to eight levels and the floor plan of the hospital changes, from smaller, separate buildings into large, coherent building plans. This means that the recommended building depth of 10.5 m (35 feet) gradually is increased to 18 meters. To reduce the total height of the build-

ing, the ceiling height – together with the height of the windows – is reduced in this period. As a consequence, the daylight no longer penetrates as deeply into the building as earlier. The distance between the buildings remains twice the distance of the total height, at least through the early period, but later in the construction period of Aarhus Municipal Hospital, also this principle is abandoned in favor of taller buildings. When it comes to planning the natural environment, the tall buildings turn out to have a negative impact. While sunlit garden landscapes originally are integrated in the planning of a hospital, these later buildings fail to provide these areas, simply because the taller buildings shade from the sun in the immediate vicinity of the buildings. By the 1930s the wards are reduced, now accommodating 10 patients, and over time they are further reduced into 4- and 6-bed-wards. This affects the corridor areas, which gradually change character up through the period. From having direct access to daylight on one side and access to wards on the other, the corridors now have rooms on both sides, with the patient wards facing SE and support rooms, etc. facing NW. This development makes it difficult to bring daylight deep in the building, which concurrently demand more electrical lighting.

The increased depths and lower ceiling heights also affect the natural ventilation, often creating uncontrollable ventilation with too little or too much draught due to the building's increased size and depth. Because of these changes, the hospitals increasingly start using mechanical ventilation up through the period. Best practice, based entirely on natural ventilation, loses ground in the revamping of the architecture that takes place in the later construction period. Instead of a recommended air supply of  $70 \text{ m}^3$  per patient per hour, the recommended air supply in patient rooms is now set to  $x1$  per hour. In a 4-bed ward of  $42 \text{ m}^2$ , this means that the air exchange is reduced from  $70 \text{ m}^3$  to approximately  $44 \text{ m}^3$  per patient per hour.

The fact that electricity prices decrease in this period, partly enables this development. However it altogether takes place because the elements sunlight, air and natural surroundings no longer are given the same health beneficial effects here, entering the Post World War period, where focus is on technology, better medical treatment, antibiotics and vaccines. Through its long-term construction time, Aarhus Municipal Hospital introduces several new innovations, during a transition period, in which, technological advances are tested and implemented, completely changing the architecture.

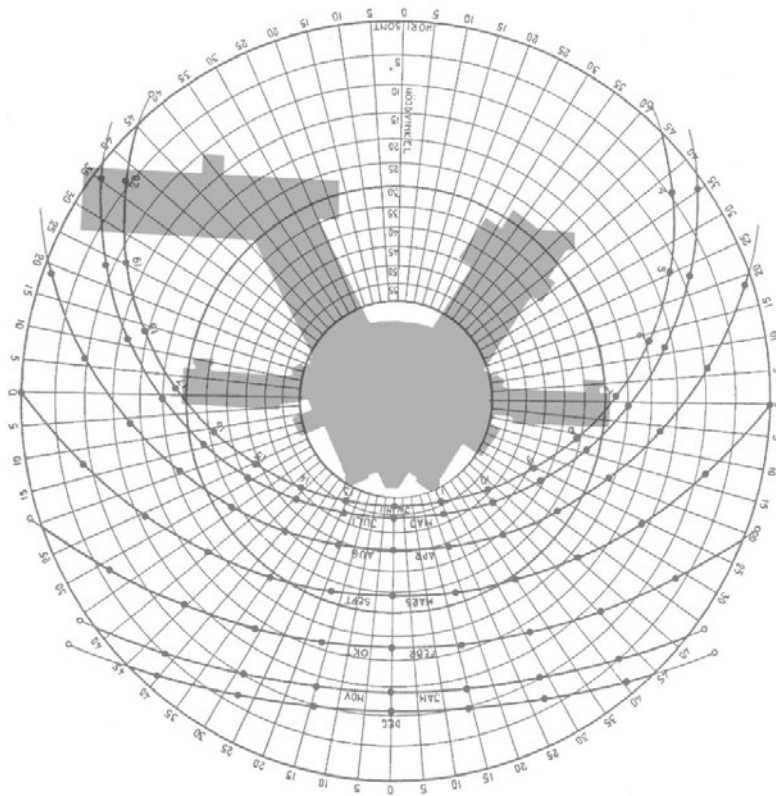


Figure 5. Glostrup Hospital 1958

## The Block Hospital

When Glostrup Hospital is built in 1958, it is one of Europe's most modern hospitals and the first ever *super hospital* in Denmark. As part of a large scale welfare plan, the hospital is a result of an international design competition, with participation of international architects such as Alvar Aalto. In this period, later named *the antibiotic era*<sup>xx</sup>, the hospitalization period is reduced from 3 weeks to approximately 1 week of length, as the average life expectancy in general also rises.

These medical triumphs affect the planning of light, air and natural surroundings at Glostrup Hospital. Although the hospital preserves earlier ideas, such as the clear low-iron glass, much change. The footprint of the hospital becomes more compact than ever before. To minimize the distances to 34 m of length<sup>xxi</sup> wards are now for the first time placed on both sides of the corridors. As a consequence, the corridors and the N and NW-facing wards receive little sunlight, and mostly indirect, reflected daylight, distinctive in the way that it does not vary much during the day, causing increased need for artificial lighting, even during the daytime. Also the recommended ceiling height is now lowered to 3 m, consequently introducing lower, horizontal windows, providing less natural ventilation and less daylight deep in the building, in comparison to the earlier tall windows, originally designed for natural ventilation.

The wards are now further reduced in size to 2-bed wards, measuring 5.5 m x 4.5 m, and over time, they turn into the first single-bed wards. While the ceiling height in the wards is approximately 3 m, the ceiling height in the corridors is only 2.7 m, now giving space for mechanical ventilation. Glostrup Hospital becomes the first hospital in Denmark based on mechanical ventilation. The horizontal windows no longer provide natural ventilation, and the



deep building design no longer provides the same opportunities for natural ventilation. Mechanical ventilation reduces the triple functions of the window (light, air, view) to a double function (daylight, view).

Having autonomy of daylight in the hospital wards and autonomy of artificial lighting in the corridors, Glostrup Hospital becomes a classic example of the clash between the two types of light, which will become the hallmark of the large hospitals in the future; too large transitions between daylight and artificial lighting creating opponents instead of interaction. The experience of a coherent building is challenged and maintained only by the necessary artificial lighting, which links the different zones together, not least during the daytime where contrasts in daylight are largest. All though Glostrup Hospital actually is planned as one of the last hospitals with clear, low-iron glass, the golden standard of the former hospital typologies, renovations mean that the low-iron glass later is replaced with ordinary float glass. A development that will continue in all the later typologies.

## The Technological Hospital

The State Hospital built in 1970 replaces The New Frederik's Hospital, an old pavilion hospital originally built in 1910, originally placed in rural settings, with plenty of light, fresh air and natural surroundings. All though The State Hospital is built at exactly the same site, it is now raised in the middle of a densely populated, urban area. The State Hospital accommodates a total of approximately 1.100 patients and is built in the central garden of the existing pavilion hospital. The State Hospital is - for this reason - compact, with a small footprint and entire 16 floors, built in a locked axis, perpendicular to the original Nightingale Pavilion axis, giving no access to the winter sun. Nightingale's knowledge about sunlight and its importance to health seems completely forgotten, and the planning of daylight now a subject to more practical and functional terms. The building design of the hospital is based primarily on flexibility in a *plan libre*<sup>xxii</sup>. Flexibility is a new, important factor, in this way, expensive rebuilding of the ever expanding and evolving medical world can be avoided. However, this flexibility, along with cheap electricity, has direct impact on the planning of light and air.

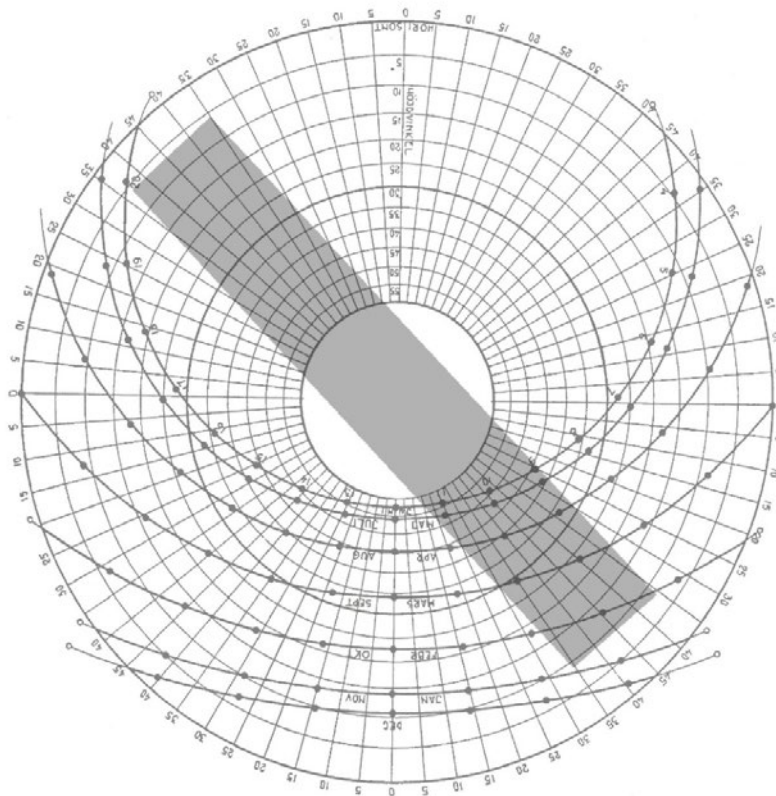


Figure 6. Plan of The State Hospital 1970. The New State Hospital 2020 is also being oriented in this axis, exactly perpendicular to Nightingale's principles applied at the earlier New Frederik's Hospital, built on the same site in 1910

The new golden standard of daylight planning in the 1960s becomes a matter of Lux, a unit that does not take into account the geographical orientation, time of day and year or any health aspects of sunlight. Possibly as a result of this quantification of light, the planning of light in this period is often considered to be poor. At this time, daylight is considered an energy problem rather than a natural source of light and good health. As the hospital is inaugurated there is greater focus on technology and the fact, that the rooms have their own telephone contact with the staff, than on the traditional elements of daylight, air and natural surroundings. The light planning does not pay respect to the sunlight, and an example of this is the pure Euclidean forms of The State Hospital, which do not make as many hours of the sunlight as Bispebjerg Hospital.

The wards remain two-bed wards, measuring approximately 6 x 5 m, however the ceiling height is now reduced to 2.4 m, consisting of steel plates, covering the 0.5 m space for a built-in mechanical ventilation. The horizontal windows only open to a very limited extent and fresh air intake primarily is provided from "the great lung"; a mechanical ventilation system located 70 m above the ground, on the 17th floor. In sharp contrast to the original thoughts and intentions of fresh air and natural ventilation at Bispebjerg Hospital:

*Windows are made to open (...) Always air from the air without, and that, too, through those windows, through which the air comes freshest*

*Because of the building's size and shape both the daylight and natural ventilation is challenged by the architecture. The building design is sharply divided into two zones; a zone with daylight and a zone without daylight and autonomy of artificial lighting. Daylight and artificial lighting is separated from each other – and from an architectural point, both elements, together with*

*mechanical ventilation, simply just added to the building, instead of being a part of it. The soft light at Bispebjerg Hospital and Aarhus University Hospital is replaced by high-contrasted light with large luminance-ratios between visual task and field of view<sup>xxiii</sup> due to the deep building design – now having a total depth of entire 36 m. Contrasts, which paradoxically make additional shielding of the daylight necessary<sup>xxiv</sup>.*

Compared to the older and smaller hospitals, singular, functional and practical problems are addressed at The State Hospital, not the general healing environment, or for that sake the trinity of light, air and natural surroundings. While focus on light and air earlier brought daylight and fresh air into the corridors – because of awareness of the healing effects of sunlight and fresh air – the focus on technology now seems to separate light and air, bringing mechanical ventilation and artificial lighting instead<sup>xxv</sup>. While natural surroundings, in the form of gardens with access to sunlight and air, originally are planned south of the hospital, they are never built. Instead, these areas are turned into parking lots for the rapidly growing number of cars in the 1970s. Easier access by car comes at the cost of direct access to natural surroundings and sunny gardens for the convalescent patients in an urban area.

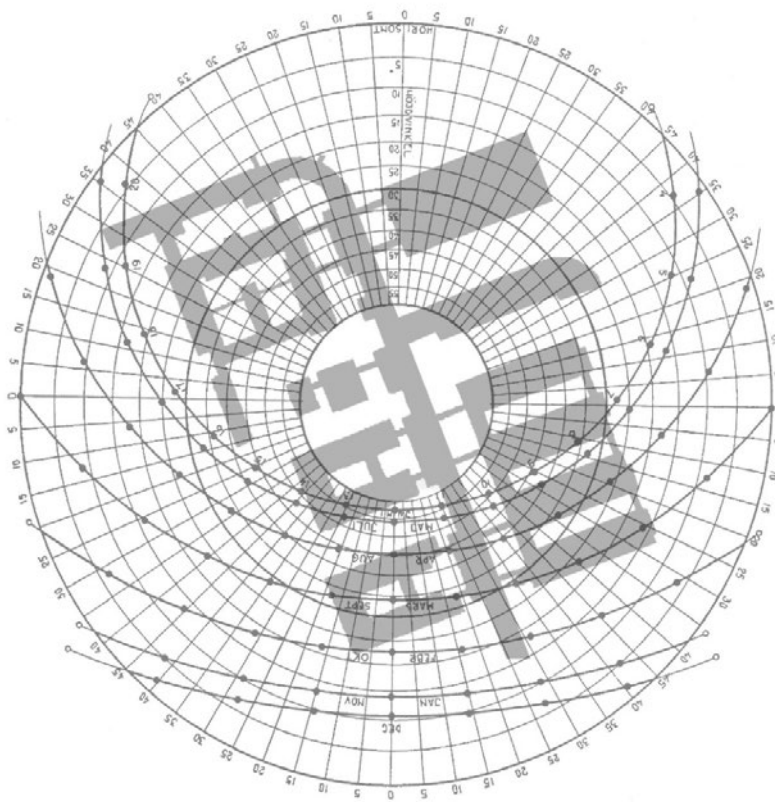


Figure 7. Skejby Hospital 1987

## The Street Hospital

Skejby Hospital, located west of Aarhus, is built in 1987 in rural settings outside the city. Both social and political agendas characterize the architecture of this period. Urbanization occurs mainly in areas outside the city and Skejby Hospital is a reaction on the large scale, compact, technological hospitals from the 60s and 70s. Instead of building a deep, compact hospital in a densely populated area, this agenda brings smaller units and a hospital in a human scale to the outskirts of the city. Skejby Hospital is built in the same

axis as the old typologies, with SE facing facades and the corridors - or more precisely streets - again having daylight and natural surroundings as the old hospital typologies.

However, the hospital is not built outside the city based on the healing aspects of the natural surroundings, but rather because of a social and political agenda. Hence, several classic health components are not incorporated into the building design; the depth of the building is deeper than the earlier recommended building depth of 10.5 m. Although the individual wards may be ventilated naturally, the entire hospital has a built in central mechanical ventilation system, placed in the basement<sup>xxvi</sup>. The hospital plan resembles several units of the earlier monastery typology, with small gardens, but without the sheltered patio they are not providing any privacy or opportunity to stay outside, regardless of wind and weather. The orientation of the hospital resembles the pavilions, facing the morning sun, although the principle of the distance equaling twice the height is not applied; the distance is less and therefore also the number of hours of sunshine is less - especially during the winter period – in contrast to the pavilion hospital. The atrium measures 17 meters x 22 meters and the area-height ratio (AH-index)<sup>xxvii</sup> is about 3.5. The buildings have up to three floors - like the pavilion hospital, only with less sunlight. The purpose of the atrium is primarily to provide skylight into the wards in order to reduce the energy consumption for artificial lighting. However, the dark brick facades and a window area of about 20% means that daylight amounts in the wards are relatively small, with an estimated average daylight factor of 1%.

All in all the street hospital attempts to revitalize the human scale and create smaller units, like pavilions, instead connected by covered, integrated streets. With the gradual extension of the hospital, these streets may be expanded and adapted as a form of covered pavilion construction. If we compare with the Hotel Dieu and the strategy to optimize natural daylight and natural air, the street hospital is the last attempt to revitalize this strategy. All though the covered streets bring daylight into the corridors once again, they do not solve the problems of the large distances between the care units, which only grows with the specialization of hospitals up through the 80s and 90s. In this way, the street hospital typology turns out to be problematic, and the benefits of the smaller units and dense, low buildings already challenged from the start. As the hospitals grow in size over the coming decades, low hospitals of smaller dimensions, are replaced by larger units, with a covered base – and with shorter radial distances, optimizing the efficiency of the staff, who increasingly need to supervise a larger number of single-bed wards.

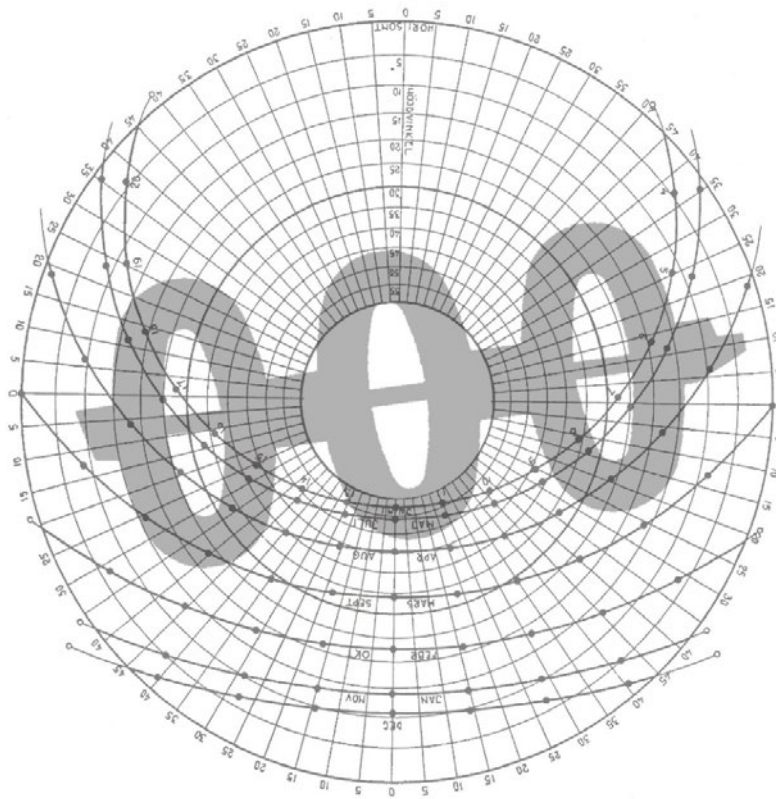


Figure 8. Birmingham New Hospital 2010

## The Base Hospital

The earlier concept of the super hospital, takes a new meaning in these years, when 6 super hospitals are build and 12 existing hospitals rebuild and expanded in Denmark. In line with the increased size, the flexibility becomes an important factor in the choice of building typology. The rapid development in medicine and technology makes it difficult to predict the future, and difficult to plan a hospital 30-40 years into the future. The base hospital typology seems to be the answer to these challenges, forming a flexible framework for the future hospitals in Denmark.

Birmingham New Hospital, built in 2010, is an example of such a typology. The hospital accommodates approximately 1.200 patients, primarily in single-bed wards. The average length of stay is now reduced to 3 days. The hospital typology provides the physical framework of several different units. The hospital is built over a campus, a central covered base, at ground level. This base is housing a large therapeutic environment with wards and patient hotels on top. Birmingham New Hospital focuses on new evidence-based knowledge<sup>xxviii</sup> about healing atmosphere and healing elements, including light, art, colors and natural surroundings.

Yet it is striking that the basic, earlier recommendations, such as the height equaling twice the distance in order to get natural surroundings and sunlight during wintertime, and openable, tall windows to have direct access to fresh, natural air, are not implemented. In the description of The Birmingham New Hospital it says:

*The architecture enables more natural daylight to enter into the building, making it possible to change function as there no longer is an inner middle zone without daylight<sup>xxix</sup>*

However, if we compare this to the previous hospital typologies, the truth is another. The building depth is deep - 16 meters - and the horizontal windows provide less daylight deep into the building. Considerably less light than the earlier tall, vertical windows depicted in the pavilion hospital. Again, shielding against the sunlight is necessary, because of the horizontal windows offering view, but also causing major problems with solar heat. Instead of 2-layered clear glass, this flexible *plan libre* facade makes 3-layered coated glass types necessary. Reducing the natural daylight with approximately 30%, 3-layered glass reduces the external heat load, and reduces the heat loss (U-value) through the windows. However, at the cost of the daylight quality, which is considerably poorer than the early 1900 typologies.

The Birmingham New Hospital is one step further in the development towards a technological hospital. The single-bed wards are ventilated fully mechanical, now with an air-flow of about 195 m<sup>3</sup> of air per hour. This is significantly more air than the recommended 70 m<sup>3</sup> per hour per patient in the early 1900s typologies. 1900s practice corresponded to about x1 air change per hour per patient - at a ceiling height of 4.2 m and a bed area of 3.3 m x 5 m per patient, while practice today corresponds to about x4 air changes per hour. Contrary to the naturally cooled air intake with an air supply temperature around 19 °C at Bispebjerg Hospital, the mechanically vented air is now air-conditioned, and cooled electrically, to 17 °C. This is costing considerably more energy and CO<sub>2</sub>, however it is needed in the energy calculations to keep the temperature down in this large, highly insulated hospital, where internal heat load from people and technical equipment, together with external heat from the sun, means temperatures above 26 °C during the day and problems with overheating.

With many of the same features as depicted at The State Hospital, the base hospital also has inherited many of the same problems in terms of a lack of sunlight and no direct access to the natural surroundings. These hospitals seem to have the monastery garden as a common theme, only with much higher and more compact buildings, where the AH ratio becomes even less, why these courtyards and gardens receive little sunlight through the winter period. The single-bed wards on both sides of the corridors again affect the building, which is deeper and darker than the earlier typologies. The hospital, being compact and located in a densely populated urban area, again means limited access to fresh air and sunlight in the immediate vicinities of the buildings.

In many ways, this hospital typology loses the regional characteristics of the early typologies and becomes a container, able to be placed anywhere, not adapting to any regional climate and daylight characteristics. The starting point of this typology, the international, evidence-based design, is resulting in what can be coined an *international hospital typology*, based on highly functional and flexible "ideal" units, as a kind of building blocks for the entire hospital. A planning designed to enable flexibility, with the façade windows and glazing bars aligned in a 300 mm grid, again a repetition of the technological hospital. These uniform construction units may be a useful, functional aspect when the building changes use – with the only fixed elements being quite basic services, which remain fixed in the middle of the hospital. However, this flexibility affects the planning of both light and air, and just like the technological hospital, the planning is completely dependent on technology when it comes to both elements. In huge contrast to the early typologies rooted in a regional architecture, based on a high performance of the building physique and very little technology.

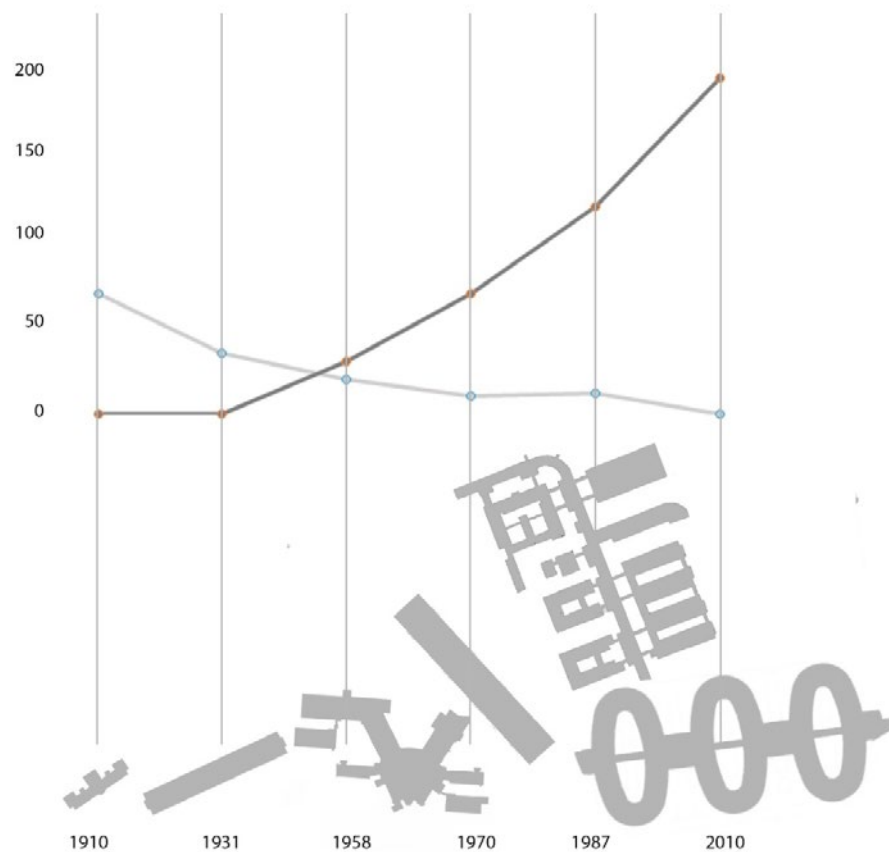


Figure 9. Schematic, historical overview of all six different typologies 1910 - 2010, their footprint, size and orientation, together with the distribution between natural ventilation (bright) and mechanical ventilation (dark), measured in m3 of air per hour per patient for each typology over time

# Discussion

This retrospective, comparative study confirms that the planning of light, air and natural surroundings has changed dramatically through the period 1910 - 2010. Originally, light, air and natural surroundings are planned as an integrated part of the building design, but through the period this planning gradually gets separated from the building design.

When it comes to light, the planning of daylight changes fundamentally. From being planned, based on health beneficial aspects, a more functional planning of daylight is practiced, based on practical, working supportive standard levels of light (measured in Lux). Light being added to the building and not integrated into the building design as earlier in the period. Instead of making the most of the sunlight, as in Nightingales era, the later building typologies seem to block and shield off the sun. Either by their plan, depth, height, orientation or different coated glass types. In the planning of these hospitals, even large glass areas do not seem to compensate for the daylight loss in a deeper and larger building design. Instead, they create problems and necessitates other forms of protection against sunlight and solar heat. Be it in the form of a substantial external screening or coated glass, reflecting and filtering the natural spectrum of sunlight. This shielding also blocks the healthy light from entering the building and the study shows that earlier recommended standards of 1- and 2-layered low-iron glass in tall windows gradually change to 2-layered coated glass and 3-layered coated glass in horizontal windows during this period. However, 3-layered coated glass results in a reduction of up to 30% of the natural daylight compared to 2-layered low-iron glass, only transmitting parts of the natural spectrum of daylight and no UVB.

Originally, the tall windows were optimized to combine light and air, ventilating rooms with depths of 2.5 times the ceiling height, by using the natural stack pressure. However, over time new, horizontal window types appear, no longer providing the same natural ventilation. In this way, the elements light and air become separated from each other in the planning of the building design. The study suggests that the separate planning of light directly affects the planning of air and vice versa. The prevalence of mechanical ventilation not only affects the windows, it also reduces the spatial volume of air from  $80 \text{ m}^3$  to  $51.3 \text{ m}^3$ , by reducing the ceiling height from 4.2 m to 2.7 m over the period (based on a  $19 \text{ m}^2$  single-bed-ward). Which again affects and reduces the average daylight factor in the building, compared to earlier building typologies based on autonomy of natural ventilation. Daylight directly being impaired by the reduced ceiling height, and indirectly by the introduction of the deeper building design, made possible by mechanical ventilation. Again, this suggests that the planning of light is closely linked to the planning of air, and they can conflict when separated into singular elements in the planning of the building design.

When it comes to air, the best practice for ventilation also changes dramatically over the period. From past practices based on autonomy of natural ventilation to today's best practice for hospitals, based on autonomy of mechanical ventilation. Over the same period, the air change per hour increases from average x1 per hour and up to average x4 per hour at the new hospitals. A study<sup>xxx</sup> by the Danish Energy Agency states that wards at hospitals with mechanical ventilation have different air changes ranging from x1 per hour to x7 per hour, with an average of x2.4 times per hour – far lower than



the new hospitals of today. All in all, it remains uncertain exactly how much ventilation is needed, and this study finds no rational explanation as to why the best practice for air has changed, and why the air change per hour has increased so dramatically over the years.

The study suggests, however, that a one-sided focus on the air-flow compromises the trinity of the elements. Firstly mechanical ventilation leads to recessed ceiling heights, compromising the daylight factor and reducing daylight-levels deep in the building. Secondly, a recessed ceiling of 1.5 m means that 36% of the bare structure of a hospital is occupied for the mechanical ventilation. In this way an 8-storey hospital, instead of 22 m, reaches a total height of 34 m. The total building height actually compromising the planning of access to sunlit gardens and natural surroundings. Again, the elements light, air and natural surroundings are closely related, directly affecting each other.

Besides providing more daylight at the hospital and more sunlight in the immediate vicinities of the hospital, natural ventilation, or hybrid ventilation, actually also offers several other positive effects. Offering advantages such as a higher user satisfaction, due to individual control of windows and indoor environment<sup>xxxix</sup> together with a higher tolerance towards any deviations in the indoor thermal climate, because the users can control it themselves<sup>xxxix</sup>. However, when it comes to introducing hybrid ventilation, it has to be ensured that the mechanical systems are working beneficial together with the natural ventilation and the windows<sup>xxxix</sup>.

When it comes to the natural surroundings, this study shows that the planning of natural surroundings is closely interrelated to the planning of air and light. In fact, the natural surroundings seems to be the starting point for the planning of light and air in the early typologies. By principles such as “twice the distance of the height” and louvred shafts, the natural surroundings directly feed the buildings with light and air, during both the summer- and winter season. This study implies that by disregarding the natural surroundings it becomes increasingly difficult – and expensive – to provide light and air in the buildings. On the other hand, past practice implies that it is possible to improve light and air, using the natural surroundings as an important tool in the planning of hospitals.

The study also implies that the trinity of these elements not only addresses a strict energy agenda, but also addresses an important health related agenda.

When it comes to the healing environment, research<sup>xxxix</sup> indicates that naturally ventilated buildings in some cases perform better than mechanically ventilated buildings when it comes to air born contagious infections.<sup>xxxix</sup> While modern mechanical ventilation systems are sealed constructions, receiving no UV-light, the fresh air intake directly through the windows in the past involved UV-light. UV-light having an antiseptic effect on bacteria, killing germs, it seems irrational to avoid it completely in the mechanical ventilation systems, which all though filtered, are highly dependent on frequent maintenance in order to remain healthy. This is further confirmed by the fact, that mechanical ventilation is no magic bullet when it comes to hospital acquired infections (HAI)<sup>xxxix</sup>, in fact mechanical ventilation systems can cause bacteria-infected illnesses and only perform as well as their general, and often quite varied, maintenance.

This study implies that there are potentials and lessons to be learned from the earlier hospital typologies when it comes to light, ventilation and health. While OP-rooms today are being planned with direct access to daylight again – after a period of more than 70 years, from 1945 until now, without daylight – perhaps the time has come to reintroduce natural ventilation in the

coming hospitals as well. Based on my own experiences from the planning of the recent new hospitals in Denmark<sup>xxxvii</sup>, this is far from being the case. The building typologies may look like the old typologies, but they do not perform like them. The building physique is not a decisive part in the planning anymore. The same applies when it comes to the daylight quality. We may learn from the past, by reintroducing 2-layered low-iron glass as depicted in the early typologies, for the benefit of the healing environment. Also introducing tall windows, integrating the original three functions of the window; light, air and view, which historically seems so closely interrelated to each other – and to the name window.

Today, Danish hospitals currently spend about 460 million. kWh of electricity and 660 million. kWh heat (degree days adjusted) annually in 2011 figures<sup>xxxviii</sup>. Energy for ventilation makes up the largest total energy consumption in Danish hospitals. Approximately 20% of the electricity goes to ventilation and about 50% of heat consumption for ventilation. Altogether, ventilation constitutes about 40% of total energy consumption, costs that eventually can be reduced if natural and hybrid ventilation is implemented. Especially at hospitals, which often are characterized by a high internal heat load causing temperatures above 26 C. Here openable windows, together with the adaptive comfort model<sup>xxxix</sup> earlier described, may be an improvement of today's best practice when it comes to energy and health. However, in this context, it is important to bear in mind that while energy may take up 50% of the planning of a new hospital today, it only takes up little part (1 - 4%) of the total estimated operating budget of a hospital<sup>xl</sup>. Way surpassed by wellbeing, sleep, recovery-time, and other qualitative health-related parameters, which all historically seem beneficially affected by the costless elements; natural light, natural air and natural surroundings.

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# Towards assessing the impact of circadian lighting in elderly housing from a holistic perspective

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## Abstract

*Circadian lighting has the potential to be used as a welfare technology, and improve the health and well-being of the general public. A research-based dynamic circadian lighting scheme can be developed using LED lighting. Testing and evaluating circadian lighting however requires a holistic approach, bringing together several different disciplines, in particular technological, medical and anthropological fields. The analysis of the tests must combine qualitative and quantitative data, and requires the use of a mixed methods approach. This paper presents the framework for such analysis for designing the evaluation of circadian adjusted lighting.*

## Introduction

With the discovery of the intrinsically photosensitive retinal ganglion cells (ipRGC) in 2002 (Berson et al. 2002), a biochemical link was made between the circadian rhythm and light. This has enabled a shift in focus from lighting as a purely visual and functional aid, to one that can equally enhance and help regulate aspects of the diurnal rhythm, and as such our health and well-being. This has made lighting a recent addition to welfare technology, which relies to a great extent on solid state lighting technologies, in particular LED lighting.

The development of lighting adjusted to support the circadian rhythm, indicated as CALED (Circadian Adjusted LED), is based on cognitive and medical studies. Yet, although tailor made light therapies have shown to remedy circadian disruptions in especially Alzheimer sufferers and night shift workers by improving sleep quality and sleeping patterns (Hanford, Figueiro, 2013, Yoon et al. 2002), they have a narrow target group, invariably resulting in highly focused therapeutic sessions. In addition, these therapies can involve many hours of session with specialized lighting platforms, making them cumbersome and intrusive. Research into the application and effects of circadian adjusted lighting on the general, and ageing, population remain in their infancy (Shikder, 2012).

The concept of lighting to assist and adjust the circadian system may increase the general health and well-being of the population, and lead to a reduced dependency on social services. As such, research into its general applicability is the next logical step. Due to the various angles of this topic, the overall study of circadian lighting requires a holistic approach. The research question is then

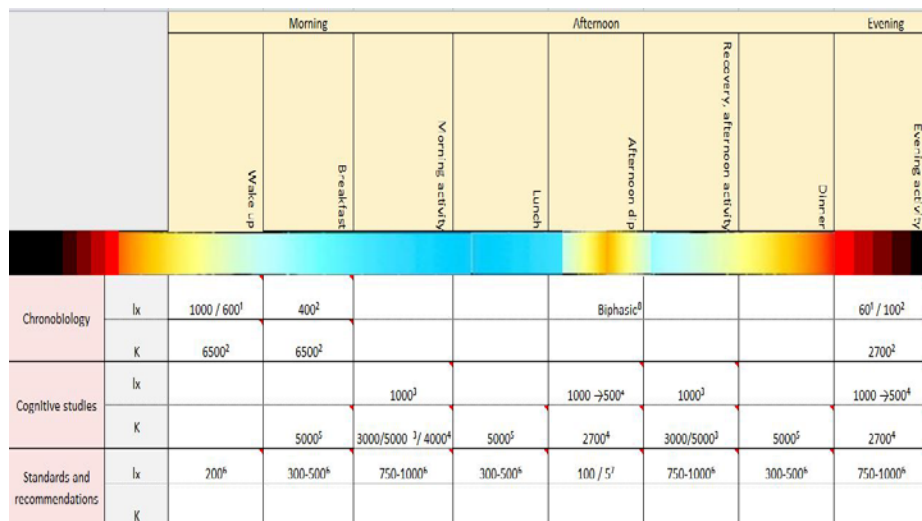
how and what methods should be used for an evaluation, in order to prove the effectiveness of such lighting. In this context, this paper presents a newly introduced mixed methods framework for designing this evaluation of circadian adjusted LED lighting. The use case of elderly housing is considered for this framework.

## Circadian lighting curve

The theoretical basis for the development of the circadian lighting scheme comes from previous chronobiological and cognitive research relating to flicker, illuminance levels and correlated colour temperature (CCT). Firstly, a number of studies have shown the correlation of CCT and illuminance on the circadian rhythm. Research by Figueiro et al. indicates that high circadian stimulation should have an illumination of at least 400 lux at the cornea and a CCT of 6500 K (blue rich light), and suggests this for daytime use. Evening hours are recommended to have an illuminance of 100 lux at the cornea and a colour temperature of 2700K (Figueiro, 2008). In a study on old and demented people, Sust et al. similarly propose a scheme for elderly with a 1200 lux and 6500 K exposure during the daytime, and an 800 lux and 3000 K exposure after three o'clock in the afternoon (Sust et al. 2012). Finally, within a working environment, Van den Beld has proposed a curve which starts at 800 lx and 6000 K at 8.00 in the morning, which gradually decreases to 500 lux and 3000 K by 12.00. This is repeated starting with around 750 lux at 12.30 which again gradually decreases to 500 lux and 3000 K at 16.00 (Van den Beld, 2002). An important aspect of research on the circadian rhythm is the study of the sleep-wake cycle. As an effect of the combination of the circadian rhythm and sleep homeostasis, sleep cycles for humans have been argued to be biphasic, although current society is interrupting this with technology (Ekirch, 2001).

Besides research on the circadian rhythm, there are equally a number of cognitive studies related to emotional response, task performance and alertness with respects to CCT and illuminance levels. Goven et al. have shown that an increase from 3000 K to 4000 K increases alertness (Goven et al. 2007). Similarly, Choi and Suk showed that 6500 K produced the greatest alertness (Choi & Suk, 2016). The same studies indicated that 100 lux produced the best emotional responses (Goven et al, 2007), and that 3500 K was associated with increased relaxation (Choi and Suk, 2016). This is equally reflected by Park et al. who found that a lower CCT of 2766 K increased relaxation (Park et al. 2013).

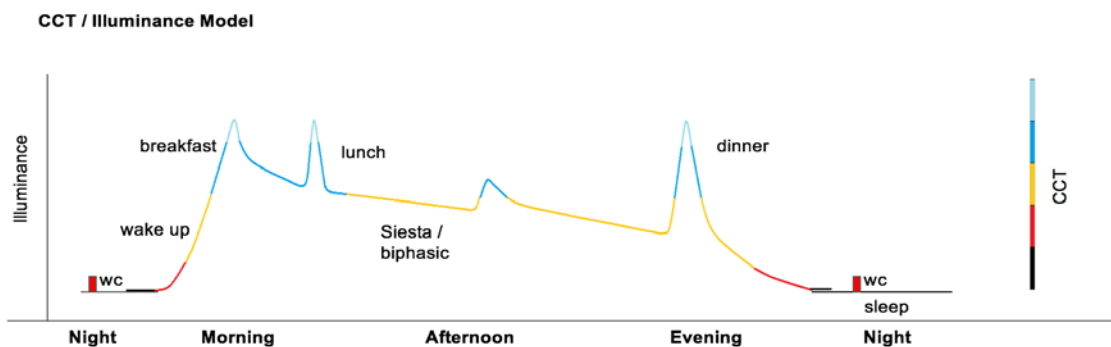
By using research a dynamic circadian lighting scheme (Figure 1) can be produced with a circadian lighting curve (Figure 2). This scheme would be punctuated by task performance requirements such as dinner, and toilet visits. The light needs to be dynamic, and change illuminance levels and colour temperature in a prescribed sequence depending on the time of day, biological needs and task requirements.



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Figure 1. Circadian lighting scheme



#### Medical requirements and recommendations:

Examination room general: 500 lx, 4000-5000 K, Ra 90 (DS EN 12464-1 2011: 5.40.1)  
 Examination, simple: 300lx (DS EN 12464-1 2011: 5.39.3)  
 Examination and treatment: 1000lx, Ra 90 (DS EN 12464-1 2011: 5.39.4 / 5.40.2)  
 Cleaning and examination: 100 - 200 lx (Styrelsen for Social Service, 2004)  
 Examination and Observation: 500 lx, 5000 K, Ra 90 (Styrelsen for Social Service, 2004)  
 Emergency lighting: 1500 lx / 5000 K: manual override button.

**Toilet:**  
 Daytime: 200 lx (DS EN 12464-1 2011: 5.39.6 / 5.2.4)  
 Night time: 5 lx, 2700 K, or amber light (Figueiro, A 24 Hour Lighting Scheme for Older Adults, 2008)

Figure 2. Circadian lighting curve

## A holistic approach: mixed methods model

Due to the complex nature of care of the elderly i.e. psychological well-being, personalized space, adaptations to functional decline, and therapeutic focus, the evaluation of a circadian lighting system for geriatric use must incorporate data

from widely dispersed fields. This trial relies on both qualitative and quantitative data from three fields: anthropological, sensor-based and medical (see Figure 3)

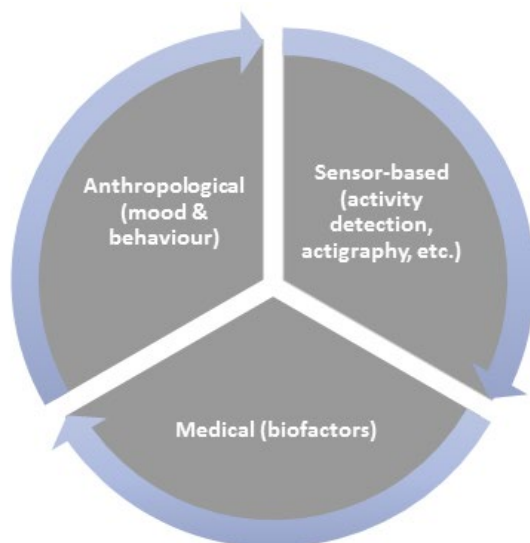


Figure 3. Holistic approach scheme

There are a number of epistemological issues in combining sets of qualitative and quantitative data (Creswell & Clark, 2011), each of which relate to the seeming incompatibility of a post-positivist approach to science and an interpretive approach. Although each paradigm in and of itself have a fairly robust system of inquiry, the comparison of results between the two i.e. a mixed method approach, warrant careful reasoning.

In this context, the framework for collecting the data will consist of a cross-over non-blinded randomized trial involving three target groups (Table 1). Groups A and B will be divided in subgroups A1, A2, B1 and B2. Group C will remain undivided. For each group the trial will take place over a 16-week period within which each subgroup will alternate between intervention and control.

Table 1.

Participants	No	Week 0	Randomization	No	Week 1-8 Period 1	Week 9-16 Period 2
Group A, frail elderly receiving CALED	15	Baseline	Subgroup A1	8	Intervention	Control
			Subgroup A2	7	Control	Intervention
Group B, residents with dementia receiving CALED	9	Baseline	Subgroup B1	4	Intervention	Control
			Subgroup B2	5	Control	Intervention
Group C, frail elderly not receiving CALED	15	Baseline	Non	15	Control	Control

The type of mixed method design depends on the research question. In this study, the aim is to enhance the knowledge of the impact of circadian adjustable lighting on the health and well-being of the elderly, and to identify what possible consistencies and inconsistencies might emerge from cross comparison of the results. This implies the use of a convergent parallel design mixed method



approach in which both of the data strands i.e. the qualitative and the quantitative strand, are obtained and analyzed separately (Creswell & Clark, 2011).

Following this model, each research field (anthropological, sensor-based and medical) will start out by obtaining and analyzing data from either a qualitative or a quantitative angle, depending on the field in question. To structure the analysis in a more precise way a two-phase model is introduced (Table 2), which is based on expanding the data analysis from the level of subgroups and methods to that of the groups and fields. Within this, *method* refers to the specific tool used for data collection, and *field* refers to the research discipline, i.e. anthropological, sensor-based and medical.

The first phase, or phase A, consists of three steps, and involves data collection and data analysis for each field and method individually. As such it does not mix qualitative and quantitative sets of data. The second phase, or phase B, consists of two steps and involves cross comparisons between methods and fields. This phase will mix qualitative and quantitative data. The following is a description of each phase and its steps:

*Phase A (individual qualitative and quantitative analysis):*

Step 1 (1<sup>st</sup> order analysis), each subgroup, i.e. A1, A2 and B1, B2 is analyzed individually based on their respective methods of observation. This is indicated as the 1st order of analysis and described as the **Intra Subgroup Sequential Comparison**.

Step 2 (2<sup>nd</sup> order analysis), comparing the results between each subgroup, i.e. A1 with A2 and B1 with B2, within their method of observation. This is indicated as the 2nd order of analysis and described as **Inter Subgroup Cross Comparison**.

Step 3 (3<sup>rd</sup> order analysis), a comparison of the results between groups, i.e. A, B and C for each of the respective methods of observation. This is indicated as the 3rd order of analysis and is described as **Inter Group Cross Comparison**.

*Phase B (mixed qualitative and quantitative analysis):*

Step 4 (4<sup>th</sup> order analysis), comparison of the results between methods of observation within the respective three fields: anthropological, sensor based and medical. Each method of observation at this step can be weighted when compared. This level is indicated as the 4th order of analysis and described as **Inter Method Cross Comparison Weighted**.

Step 5 (5<sup>th</sup> order analysis), comparison of the results across the methods and fields. This is done along well defined lines and queries, and forms an important aspect of the data-transformation merged analysis variant of the parallel convergent mixed method design. This level of analysis is indicated as the 5th order of analysis and described as **Inter Field Cross Comparison**

Table 2.

	Research question	Whether circadian adjusted lighting has an impact on the health and well-being of elderly people												
		Quantitative										Qualitative		
	Outcomes (Dependent variables)	Light exposure		Sleep assessment	24-hour Mobility	Delirium	Daytime sleepiness	Sleep Quality	Depression	Health related quality of life	Independence	Cognition	Experience and practice (rhythm, routes and routines)	
	Methods of data collection	Sensors	Lighting On/Off	ActiWatch	ActivPal	Blood test	Structured Questionnaire					Interviews	Social -Mapping	Observations
Phase A	Intervention and 1 <sup>st</sup> order analysis Intra subgroup sequential comparison (for each test)	A1I - A1C → A1*												
		A2I - A2C → A2*												
		B1I - B1C → B1*												
		B2I - B2C →B2*												
	2 <sup>nd</sup> order analysis Inter subgroup cross comparison	A1-A2→A*												
		B1-B2→B*												
	3 <sup>rd</sup> order analysis Inter group cross comparison	A – B												
		A - C												
B - C														
Phase B	4 <sup>th</sup> order analysis Inter method cross comparison weighted	Comparison of results between methods within each field												
	5 <sup>th</sup> order analysis Inter field cross comparison	Comparison of results from 4 <sup>th</sup> order analyses between fields												

## Quantitative survey

The aim of the quantitative survey is to investigate the circadian rhythm by looking at changes in associated outcomes for sleep quality, delirium, and well-being defined as physical and mental functioning (Okawa et al. 1991, Slatore et al. 2012).

## Quantitative data collection

The trial participants will be assessed at baseline, and after 4, 8, 12 and 16 weeks, respectively. The test panel will consist of questionnaires, functional and cognitive tests, and a blood sample for detecting underlying causes of delirium and illness during the trial. A full test panel will be used at baseline, after 8 weeks and after 16 weeks; with a smaller test panel being used after 4 weeks and 12 weeks. The tests are supplemented by sensory data from wrist and leg worn monitors in weeks 1, 4, 8, 9, 12 and 16. An overview of the outcomes to be assessed is presented in Table 3.

Table 3.

Variables	Baseline	4-week	8-week	12-week	16-week
<i>Primary outcome: quality of sleep</i>					
PSQI; total sleep time	x	x	x	x	x
<i>Secondary outcomes: sleep efficiency, mobility and immunological status</i>					
1. Actigraphy, Actiwatch; sleep and wake activity	x	x	x	x	x
2. ESS; daytime sleepiness	x	x	x	x	x
3. Biomarkers; immunological status	x	x	x	x	x
4. CAM; delirium and confusion	x	x	x	x	x
5. MoCA, MMSE; cognition	x	x	x	x	x
6. MDI; depression	x		x		x
7. ActivePal; mobility	x	x	x	x	x
8. EQ-5D; well-being	x		x		x
9. ADL; self-efficacy;	x		x		x
<i>Additional variables</i>					
10. Registration; medication	x		x		x
11. IVI-test; vision	x				x
12. MNA; nutritional status	x		x		x
13. Personal light exposure; Actiwatch	x	x	x	x	x

PSQI: Pittsburgh Sleep Quality Index; ESS: Epworth Sleepiness Scale; CAM: Confusion Assessment Method; MoCA: Montreal Cognitive Assessment; MMSE Mini Mental State Examination; MDI: Major Depression Inventory; EQ-5D: EuroQol; ADL: Activities of Daily Living; MNA: Mini Nutritional Assessment

## Quantitative data analysis

Data will be presented as means with standard deviations, medians with inter-quartile ranges or frequencies with percentages depending on the distribution of the variable. The primary analysis for the primary outcome will be performed using the SAS procedure PROC MIXED (dif(intervention-control)). The difference in the PSQI scores between the intervention period and the control period will be analysed using mixed models, with treatment (intervention and control) and period (period 1 and period 2) as fixed effects and the participant

identification as random effect. Secondly, the models will be adjusted for baseline PSQI scores.

The primary analysis will follow the intention-to-treat principle using multiple imputations in case of missing outcome measures. For the secondary outcomes, similar analyses will be performed. Moreover, all analyses will be repeated using adjustments for baseline vision. All models will be investigated for goodness-of-fit (linearity, variance homogeneity and normal distribution of residuals) by visual inspection of plots and remodelling will be performed accordingly. All statistical tests will be performed using SAS (SAS Institute Inc, Cary, NC, US) and p values  $\leq 0.05$  will be considered statistically significant.

## Qualitative survey

The aim of the anthropological study is to reveal changes in experiences and practices of everyday life with an emphasis on how elderly experience and practice their home, as a consequence of the intervention, from a phenomenological perspective (Curry, Nembhard, & Bradley, 2009). In instrumental terms we will look into changes in rhythms, routes and routines which will give an indication of the essence of what it means to practice home. The assumptions are that a house or apartment is not automatically a home but is something which is created through practice (Vacher, 2006), and that experience and practices are related to well-being of the participants.

The major outcome of the anthropological survey is well-being from a holistic point of view taking into account the context and culture of the participants. Where the medical survey looks at well-being defined as physical and mental functioning from a medical perspective, the anthropological survey will look at well-being with the assumption that well-being is not a universal parameter which is easily comparable between subjects but is individual where the context and the lived experience of the individual plays a big role. Quantitative measures of well-being have been criticized due to not being able to cover cultural bias (Ryan & Deci, 2001) and the use of mixed methods overcomes this issue.

## Qualitative data collection

The participants of groups A, B and C will be surveyed at baseline (see Table 4), which for the anthropological study is before the new fixtures is going to be installed in the participant's' apartments and will show the impact of change from using their own fixtures to using the intervention fixtures. Group A and B will then be surveyed every 3<sup>rd</sup> week within each period (week 1-2, week 4-5 and week 7-8). Group C will be surveyed twice for each period. The major purpose of group C is to control the confounding variable, seasonal change, and less emphasis is therefore put on developing rapport for this group.

The early surveying of a period will show immediate effects and implications of the intervention, before participants have had time to adapt to their new context and surveying late in the period will show effects when rhythms, routes, and routines have become more stable. The early and plentiful contact points between the interviewer and participants will also serve to develop rapport with the participants which will increase the quality of the data gained from the survey (Spradley, 1979).

Table 4.

		Period 1 (Intervention/control)								Period 2 (Intervention/control)							
Week	Baseline	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Group A, frail elderly receiving CALED																	
Interview	x		x			x			x		x			x			x
Social mapping	x		x						x		x						x
Group B, elderly with dementia receiving CALED																	
Observation	x	x			x			x		x			x			x	
Staff interview	x	x			x			x		x			x			x	
Group B, frail elderly not receiving CALED																	
Interview	x			x			x				x				x		x
Social mapping	x			x							x						x

### Semi-structured interviews and social mapping (Group A & C)

Group A and C will be surveyed by interviews and a social mapping exercise which will look into how the participants practice their homes through rhythms, routes and routines and their relation to light.

The interview guide will be built on Spradley's (1979) ethnographic interview, for the method's ability to gain in-depth information about perceived reality from the participant's point of view. The semi structured interview format will allow comparing between participants and allow hypothesis testing (Leech, 2002), and at the same time be flexible to what the participants tells us.

The interview will be supplemented by a social mapping method which is inspired by cartography (Roessler, 2015). The method is also used within environmental psychology to show relationships between actors and their environment and provides insights about the subjective experience of the built environment describing patterns of behaviour (Roessler, 2015). Mapping how the participants use light in their homes will provide useful data for tracking use of the environment before and after the intervention while at the same time serve as a nonthreatening way of starting the relationship between interviewee and interviewer. Therefore this method will be used in the beginning of the interview.

### Observation and staff interviews (Group B)

Interviewing as a method is limited by the discrepancy between what informants say and what they actually do, among other issues due to recall bias (Bernard & Gravlee, 2014). The issue of recall bias is especially prominent for people with dementia and interviewing this group requires careful attention because informants are likely to also have reduced capacity to articulate meaning, consequently making interviewing difficult. Because several participants from group B suffer from moderate to severe dementia, we will instead use observation in the common living room of the dementia ward, combined with semi-structured staff interviews (Hubbard, Downs, & Tester, 2003).

The observation will be semi-structured with a moderate degree of participation which will allow informal talks with the participants. The observation will look into the behaviour of the participants, and look at changes in their rhythms, routes and routines, with a special emphasis on daytime drowsiness, and how they interact with the light in the space.

From initial interviews with staff from the dementia ward it was learned that the residents' mental state varied a lot throughout the day. To account for this issue, staff interviews will be used to account for non-representative observation sampling, and also as a proxy interview to elucidate the view of the dementia patients based on the idea that the staff are experts in interpreting their behavior (Hubbard, Downs, & Tester, 2003). The staff interview will be a semi-structured interview which will touch upon the same themes as the interview for group A and C but will go into less detail.

### Qualitative data analysis

The qualitative data will be analyzed from a phenomenological perspective by thematic coding and looking into routes, routines and rhythms. Thematic coding (Aronson, 1994) is chosen over lifeworld analysis (Dahlberg, 2006) in order to make comparison between qualitative and quantitative data easier, while maintaining the complexity of the context in the themes.

The analysis will be deductive in the way that we already know what aspects to look for: well-being, sleep, activity, exposure to light, but the analysis will also have an inductive and iterative character (O'Reilly, 2008) in the way that it will be open for new emerging themes and theories which will help to describe the complexity of the processes and impacts of the intervention which are not anticipated. The data will then be analyzed according to Table 2, phase A, and the emerging themes will be presented along with quotes and contextual descriptive information.

### Mixed data analysis

Although it is possible within the mixed method approach to keep the resulting data separate in the analysis stage, this survey will quantify the qualitative data to make a more direct comparison possible. As such it will employ the data-transformation variant of the convergent mixed method design (Creswell & Clark, 2011). This variant results in a scheme indicating statistical relevance between sets of data, while at the same time preserving the richness of the qualitative data. In this study the majority of quantitative data will stem from the medical tests and the results from the tracking devices for mobility. Qualitative data will be obtained from the semi-structured interviews and a social mapping exercise.

The data-transformation variant refers to the comparison of qualitative and quantitative data of the overall study, and occurs in phase B of the structural model of analysis (Table 2). As such it involves the **Inter Method Cross Comparison Weighted** and the **Inter Field Cross Comparison** steps of the analysis, implying that at this step certain data can be weighted, and certain results can be compared across the various methods and across the three fields of inquiry.

## Conclusions

With the rapid population ageing in Europe, there is an increasing interest in technologies and designs that can support the elderly citizens in sustaining well-being and health along with preventing functional decline. To date, the designs of lighting systems in elderly housing are simple and primarily made to support only visual acuity without taking into account other parameters. But elderly people have higher demands on quality of light as their body has to cope with immobility, pathologies and age-related functional decline.

To this regard, there is a strong research effort in adjusting lighting design in order to improve well-being and comfort levels, as well as to meet the needs of elderly people at home. To this goal, circadian adjusted LED-based lighting is used, which can reflect the rhythm of out-door daylight. Based on the latest research a circadian lighting curve is proposed. But strong and holistic evidence for the use of such circadian lighting is still missing

In this context, this paper presents a fully developed framework for performing a holistic evaluation of circadian lighting. More specifically three different types of data are considered and cross-checked: a) medical (biofactors), b) sensor-based (activity detection, actigraphy, etc.) and c) anthropological (mood and behaviour). A convergent parallel design mixed method approach is then used following a 2-phase plan. By using this framework, a holistic evidence can be defined and support the use of circadian lighting.

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# Designing an Artificial Lighting Scheme usable for all

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## Abstract

*In 2012, the headquarters of the umbrella organisation 'Disabled People's Organisation Denmark' (Danske Handicaporganisationer) inaugurated an office building which offers workspace for the administrations of all the member organisations. The ambitions for the building were high - in the brief, it was stated that the building would introduce groundbreaking levels of accessibility, making it the most universally accessible office building in the world, allowing anyone regardless of physical disability to move around freely in the house and work in any of the offices. This includes an artificial lighting design which makes it possible for the blind and visually impaired to use the building in a self-reliant manner whether they be seated at their working desks or moving around the building, as well as suitable for optimal lip-reading to the deaf and hearing impaired.*

*Based on a post-occupancy evaluation conducted 2 years after the organisations moved in, which includes both quantitative measurements and qualitative registrations and data from interviews with users of the building, the present paper evaluates the artificial lighting design for the corridors and the central atrium. An important aim was to establish artificial lighting which could effectively guide the blind or visually impaired through the building while at the same time ensuring the kind of lighting usable for the hearing impaired when lip-reading.*

*Based on the evaluation, this paper discusses how this lighting design is experienced by its current users and how it performs in relation to the users' needs. These discussions are put in relation to established standards regarding light for the visually as well as hearing impaired. The paper focuses on the qualities of light in relation to the space for which it is designed as well as the aspects of light that are important when planning working spaces for physically disabled users.*

**Keywords:** *Visually impaired, hearing impaired, accessibility, lighting standards, lighting design.*

## Background

In 2012, the umbrella organisation 'Disabled People's Organisation Denmark' (*Danske Handicaporganisationer* – henceforth referred to as 'DH') moved into a new office building (DH Domicile) which was planned and built with the ambition of being the World's most universally accessible office building. The ambition was to allow anyone, regardless of any kind of physical disability, to be able to freely move around and self-reliantly work in the building's corridors and offices. This ambition puts great demands on the building, not only regarding level access to people in wheel chairs, but also regarding many other groups of users including the visually and hearing impaired.

The aim was to construct a building which integrates accessibility in the general design – that is; without specialized solutions for any particular group of people. The winning consortium developed the rule; one solution for all people when possible – alternatively, when impossible due to conflicting needs, two or more equally functional solutions.

When it comes to the hearing impaired and visually impaired, both groups of users rely very much on lighting in order to orientate themselves and decode their surroundings and the people around them. Qualities of light within the lighting design are therefore of great importance. Based on a post-occupancy evaluation which includes the design and building process, measurements, and user experiences of the finished building, this paper will look into how the artificial lighting design has been applied in the distribution areas of the building.

Drawing on the guidelines for lighting design for people with hearing and visual impairment, the following questions are asked:

*How is the artificial lighting in the atrium and the corridors of the DH Domicile designed? Does the lighting design of the atrium and the corridors meet standards and requirements? Does the lighting design meet the qualitative parameters for lighting described in lighting theory and guidelines; an abundant light level, a shadow pattern that highlights form, and a balanced contrast?*

## Legislation and guidelines on light

The most important purpose of a lighting scheme for office spaces is to supply the occupants with applicable and useful light. In general, a good visual environment rely on a light setting that enhances the surroundings and gives a visual impression based on three parameters; an abundant light level, a shadow pattern which highlights form, and a balanced contrast which does not contribute to glare.<sup>i</sup> This means that the success of lighting schemes does not rely on the lux level alone but mainly on the way in which the light is organised, performed and designed.<sup>ii</sup> When it comes to visually or hearing impaired people, it is of crucial importance that the lighting scheme performs in relation to all three aspects of light.

In general, the Danish legislation has very few guidelines regarding artificial light. The *SBi Guidelines 230*<sup>iii</sup> add three aspects to the Danish building regulations from which especially elderly and visually impaired people will benefit: Lighting should be directional, it should highlight important entrances or intersections of shared access routes, and it should be glare-free.

These guidelines are repeated in the SBI accessibility checklist. Here, further references to the Danish Standard *DS 700* are found, a standard which also served as a guideline for the DH Domicile.<sup>iv</sup> The checklist stresses the general need of higher light levels without glare for visually impaired people and describes the appropriate colour scheme as having a contrast in the reflectance of surfaces (LRV) in order to visually enhance different physical elements. It recommends a difference in reflectance between wall, baseboard, door, and door framing of at least 0,4 (30 LRV) and a difference of 0,75 (60 LRV) when it comes to areas that need extra attention (steps etc.).

The most detailed guidelines are described by the *Danish Association of the Blind* (Dansk Blindesamfund – henceforth ‘DB’).<sup>v</sup> They have recommendations and guidelines for lighting based on their specific target group. It is not part of the Danish legislation, but offered as a service, pointing out its particular interest in improved functionality for people with reduced vision, whereas the effectively blind have little or no use for lighting regulation. DB furthermore points to the fact that visually impaired people are not a homogeneous group of people with exactly the same preferences but constitute a wide range of different needs and preferences. DB also points out, in addition to the previously mentioned artificial lighting standards, that high levels of light need to be accompanied by smooth transitions between dark and bright environments, that backgrounds must be kept darker than foregrounds, and that shadow patterns must be well-balanced in order to avoid glare. Especially shadow patterns are described in detail as they are visually essential for defining and understanding forms and judging distance.

As mentioned above, Danish legislation has very few guidelines regarding artificial light. The legislation does emphasise the needs of elderly and visually impaired people, but more detailed description of optimal lighting conditions is offered by DB. There is no legislation for a lighting scheme for hearing impaired people, even though this group has to rely on vision and the visual environment for lip-reading and orientation. Therefore, the The Danish Association of the Hard of Hearing (Høreforeningen) recommends following the more detailed guidelines of lighting design offered by DB.<sup>vi</sup>

This means that both the visually and hearing impaired benefit from good lighting designs that support a well-functioning visual environment. A lighting design that supports physical environments through: directional light which highlights important entrances or intersections of shared access routes; light which describes the boundaries and shapes of rooms etc.; light which offers well-balanced contrasts without glare (concerning the reflectance from surfaces); and light which entails a shadow pattern that enhances form and distance.

## Method

A post-occupancy evaluation of the building was conducted two years after the organisations moved into the new building, including qualitative interviews with the users of the building and both quantitative measurements and qualitative expert evaluation.

In order to gain insight into the design and building process, interviews with representatives from all the involved parties were conducted before the building was finished. The interviews included questions about the use of knowledge, research and user involvement.

The artificial lighting scheme for the corridors and the atrium was evaluated through both quantitative and qualitative registrations. The quantitative

measurements describe the light level measured in lux (illuminance) and the distribution of the light in the room (iso-lux curves), the latter describing how light levels vary throughout specific parts of the corridors and the atrium.

The qualitative registrations included a visual registration describing the lighting scheme through its experienced light level (luminance), contrast, colour (reflectance), and shadow pattern. The registrations reflect the importance of the fact that a lighting design always has to be evaluated in relation to its context, as light and context (i.e. wall colour and texture) always interact and together make up the actual light that we experience and relate to.<sup>vii</sup>

The qualitative and quantitative registrations were combined with qualitative data from semi-structured interviews with 41 daily users of the building, including persons with and without impairment. In the interviews, they were asked about their visual and acoustic experience of moving around the corridors and the atrium, including specific questions about their experience of light in the atrium and the corridors combined with more general questions concerning their overall sensation of these areas of the building (whether they felt comfortable there and found it easy to find their way around). The interviews were recorded, transcribed and coded in order to separate the environmental qualities addressed.

## Building process

In the brief for the building there were very few specific requirements regarding accessibility. Instead, the brief asked for integrated accessibility and equality in the solutions as the client (DH) and their client consultants wanted the architects and engineers to develop new and innovative solutions. But when it came to lighting, there were quite specific demands defined with reference to standards and particular specifications for lux levels.

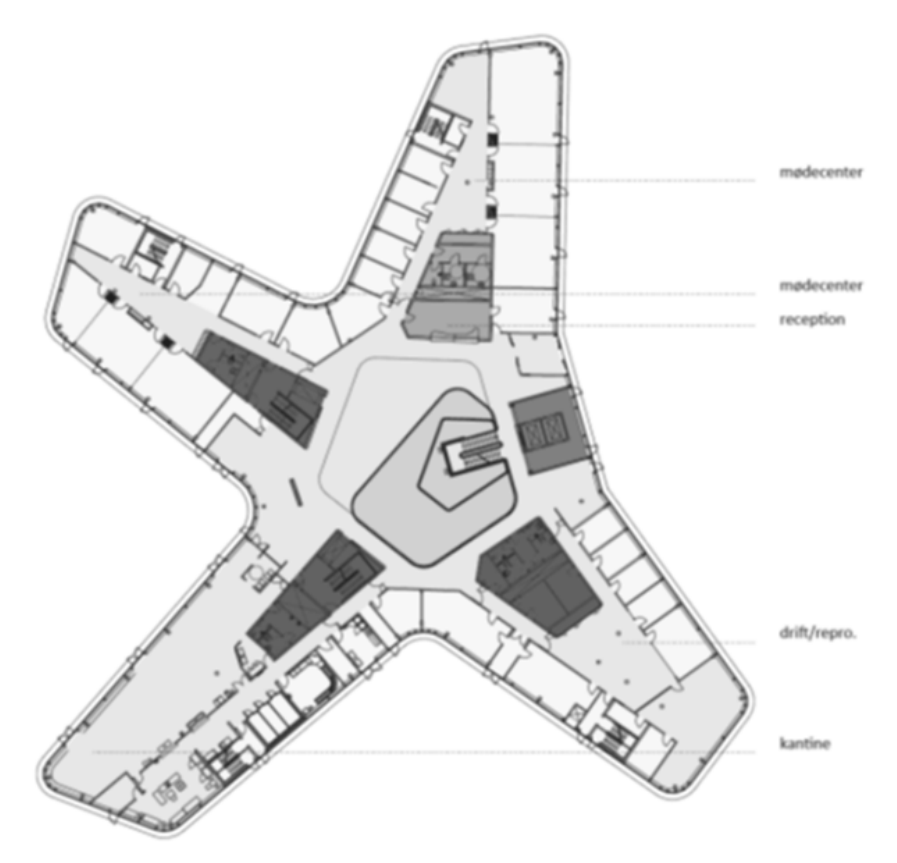
It was required that the lighting in general be in accordance with the standard DS 700 (Danish standard concerning artificial light) regarding glare, representation of colours, regularity and intensity. When it comes to the lighting in the corridors and common areas, it was required that the intensity on the floor be 200 lux, that the contrast between floor and walls be accentuated, and that there be no wall-mounted light fittings.

In the design and planning process, users were involved and tested several lighting concepts and fixtures for the corridors. This was done in the former office building of DH, with the aid of one hearing impaired and one visually impaired in dialogue with the client representative, the client's consultant, and representatives from the architect, the engineer and the contractor. The experiences of the two different users differed; what was experienced as good and sufficient light for the hearing impaired in order to decode other people's faces and lip-read, was experienced as insufficient and unusable for orientation by the visually impaired. Based on this test and the divergence in the users' experience, it was decided to give priority to the visually impaired's need for orientation in corridors, as this group rely heavily on the light to find their way around the building – the primary function of a corridor – whereas the hearing impaired use the light mainly for communication, which was considered in this case a secondary function.

## The lighting design implemented in the atrium and the corridors

When you enter the building from the main entrance, you come directly into the central atrium. The building of the DH headquarter has the shape of a starfish with only four arms and with the atrium in the centre. The atrium is the heart of the building containing functions such as reception, coffee area, meeting rooms and an informal meeting point, and gives access to the corridors with their offices. The four-floor high atrium has the form of a pentagon with balconies lining an open space which visually links all the floors. Each of the four arms of the starfish (holding the offices) has a double corridor, with a core in the middle which contains functions such as tea kitchen, toilet, printing room etc. Each of these cores has a colour code which differs from the cores of the other corridors, which is part of the wayfinding scheme of the building. In the atrium, the end wall of the cores of the four corridors outline the atrium, so that the different colours are visible.

Above the atrium, a large skylight covers the entire ceiling and provides a large amount of daylight. The skylight has no shading and therefore sunlight and light from the sky enters the space unobstructed giving the occupants the possibility of experiencing the changing character of the daylight and its variation throughout the day and during the different seasons. This is a quality which is often referred to when the occupants describe the atrium.



Artificial light is turned on and off automatically, based on sensors measuring the interior light level. Underneath the balconies, the artificial light is positioned as build-in fixtures in the ceiling that guide the light downwards. The ceiling consists of square ceiling sheets parallel to the sides of the pentagon in an orthogonal layout changing direction in each of the five corners. As the build-in fixtures follow the orthogonal web of the ceiling, which only corresponds somewhat to the form of the space underneath, the light does not enhance the spatial form of the atrium. Likewise, the orthogonal web does not emphasise the coloured walls that outline the atrium; the walls are lit by an uneven and somewhat 'spotty' lighting. Nor

does the orthogonal web allow a highlighting of the place where the corridors connect with the atrium. All in all, the artificial light does not underline the structure of the space and does not play an active role in clarifying the space for the user of the house. Thus, the artificial lighting around the atrium does not add to the accessibility for the visually impaired.

As mentioned before, people with hearing impairment also need good lighting conditions in order to be able to see faces and lip-read. This requires a lighting design with sufficient light intensity and capable of supporting the reception of the shape of objects and people. Due to the design of the atrium and the large skylight covering, the light level is high, but the light's ability to enhance form is little. The high light level can, in some cases, compensate for the low ability to create shadow patterns to support the form of objects and people in the atrium, as can the other qualities of the atrium space.

All in all, the artificial lighting does not highlight the entrances of the corridors, nor does it help describe the form of the space. The distribution of light is fairly even, and the light level is relatively high without creating glare, but also without the ability to create the necessary shadow pattern.



The corridors placed in arms of the 'starfish' have no daylight but are solely lit by artificial light. As mentioned above, the cores in the arms have differing colours to make the arms stand out from one another. The walls in the corridors are coloured on one side and white on the other. The white walls have a high reflectance (LRV), reflecting 0,88 (%) of the incoming light. The coloured walls are painted in either brown (LRV 0,31), red (LRV 0,26), green (LRV 0,32), purple (LRV 0,37), or blue (LRV 0,42). Only the blue wall stands out as having a significantly higher reflectance, while the others are close to one another, as illustrated by the values referred to here.

When the corridors have different colours but nearly the same reflectance, it is difficult to differentiate between them. This means that one has to be able to differentiate the colours as such and cannot be helped by observing the brightness of the colours alone. It would, thus, have been useful if both colour and brightness differed from one another. This is mentioned by one of the visually impaired daily users:

*"I find it hard to find the corridor in the morning. That is because I am having difficulties distinguishing the colours. So, I cannot use the colours... But I have some marks, we have some black posters hanging in our corridor, and I look for them; if there are some big pictures, it is the right corridor."* (deaf-blind, employee)



The colours of the walls in the corridor all differ in reflectance from the white walls and doors, and in that way support the wayfinding of the visually impaired when walking down the corridors. The light is quite evenly distributed and only where the corridors end up in an open office space at the bottom, there is a risk of glare because of the large differences between the light level in the artificially lit corridor and the day-lit office space.

As in the atrium, the artificial lights in the corridors are mounted in the ceiling as built-in fixtures, and show the direction of the corridor space.

But here the fixtures are placed asymmetrically and the light is directed towards and down the coloured walls. By placing the light fixtures asymmetrically, the shadow pattern could potentially vary from one side to the other, giving people and objects in the corridor a bright and a less bright side. A light setting that will, typically, enhance form and make people and objects appear more clearly.

The bright white wall to the one side reflects more light than the coloured wall to the other side. If the light were directed towards the bright wall, the shadow pattern and the distribution of the light would have created a very bright side and a less bright side and thus a clear shadow pattern. Unfortunately, the light fixtures are directed to the coloured side, and thereby the effect is nearly neutralised and the difference between the two sides of the corridor nearly even out. This, along with other aspects of the lighting design (as illustrated in the description of the atrium) means that the aim of enhancing the visual environment and creating better conditions for both the visually and the hearing impaired is not fully accomplished.

## Conclusion

Both the atrium and the corridors are essential for finding one's way around the house and can, thus, be seen as important 'landmarks' in the organisation of the house. Especially for the visually and hearing impaired users of the house, it is essential that the lighting design support the spaces of rooms and corridors, thus offering guidance and the possibility of self-reliance.

Unfortunately, the artificial lighting design of the atrium does not accentuate the shape of the room nor does it highlight the location of the entrances of the four different corridors. Therefore, it is difficult for many of the visually impaired users to orientate themselves by way of the lighting and to find their way to the right corridors.

The evenly distributed artificial light does not contribute to establishing a variation in the light and thereby a shadow pattern that might otherwise inform users through their sensation of form and depth.

Furthermore, the colours of the corridors have nearly the same reflectance, which makes it difficult to distinguish one colour from another and thereby one corridor from another.

The light setting in the corridors meets the recommendations of regulations and guidelines to a certain degree. The lighting directs traffic along the corridor space and the reflectance differs between walls and doors, making it possible for the visually impaired to find their way. The light setting of the corridor is asymmetrically organised with the intention of creating a shadow pattern that enhances form. But, unfortunately, the effect is neutralised by the light fixtures having been directed towards the coloured side, which evens out the difference in reflectance between this side and the opposite (white-painted and thus otherwise brighter) side.

There is very little help to find in the legislation and standards for artificial lighting design. In general, these are very poor and relate primarily to the quantitative aspects of light. The most elaborate guideline is made by the *Danish Association of the Blind*, where the specific needs of this user group are described. This guideline relates to both the quantitative and the qualitative aspects of light and emphasises the importance of the qualitative aspects. As the qualitative light setting support optimal visual environments, the hearing impaired also suggest following these guidelines. Both the visually and hearing impaired may benefit from the same qualitative lighting scheme.

Based on qualitative registration as well as quantitative measurement of the lighting design scheme for the DH Domicile, including the reflectance of colours, it is evident that the light setting is not optimal. The lighting design meets the general demands and guidelines but would have benefitted from an extra effort at ensuring effective solutions, perhaps by means of further user involvement. The lighting design solutions, thus, reflect a lack of in-depth knowledge on how light is experienced and on how light can enhance physical surroundings and create a conducive visual environment. The lighting design is not sufficiently orientated towards the qualities of light, i.e. shadow patterns, which enhance form, establish balanced contrast without creating glare, and allow for a light distribution that effectively supports the reception of shapes and spaces.

In general, the lighting design of the DH Domicile is conventional and works reasonably, as it would have in any office space. But the design neither meets the guidelines for creating spaces for the visually and hearing impaired nor the high ambitions for the building project. An opportunity for creating a lighting scheme that might have been inspiring and exemplary for these specific groups of users and that might have illustrated how a well-designed lighting design scheme may be conducive for universal design has, thus, been missed. This illustrates the need for a more qualitative approach to designing light settings that effectively meet the needs of the intended users.

<sup>i</sup> Boyce, Peter R.: *Human Factors in Lighting*, Second edition. Taylor & Francis Group, London, New York, 2003

<sup>ii</sup> Liljefors, Anders: *Lighting – visually and physically*, Lighting Department, School of architecture, KTH, Stockholm. 1999

<sup>iii</sup> De Place Hansen, Ernst Jan (red.): *Anvisning om Bygningsreglementet 2015, Sbi anvisning 258*, Statens Byggeforskningsinstitut, Aalborg Universitet, København, 2016

<sup>iv</sup> Dansk Standard om belysning DS700 er siden blevet erstattet af den europæiske standard DS/EN 12464-1 Lys og belysning

<sup>v</sup> <https://blind.dk/maerkesager/tilgaengelighed/tilgaengelighed-for-blinde-og-svagsynede-tibs/6-lys-2013-om-elektrisk-lys-og-synsnaedsaettelse>

<sup>vi</sup> <https://hoeforeningen.dk/media/1097/hoeforeningens-tilgaengelighedsguide-2010.pdf>

<sup>vii</sup> Mathiasen, Nanet: *Nordisk lys, og dets relation til dagslysåbninger i nordisk arkitektur*, Det Kongelige Danske Kunstakademis Skoler for Arkitektur, Design og Konservering, København, 2015.

# The Luminaire Window

## Dynamic led light supplementing the daylight intake, to meet biological needs and architectural potentials in healthcare

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# Abstract

*The importance of dynamic light to support health and well-being is being more and more recognized. People in healthcare environments have a specific need for optimized daylight conditions due to limited access to outside spaces and stress- and pain-related conditions. Especially elderly people, as well as caregivers who work on day and night shift have a specific need for stimulating the circadian rhythm, through circadian light.*

*Daylight penetration through window openings is crucial for maintaining a healthy sleep-wake pattern. At the same time, the window can provide a pleasant view and connection to the surroundings, and enhance the perception of the interior space and materials. All three factors are recognized as important for human well-being and health. Nevertheless, they are seldom considered in a holistic lighting design or development of windows and luminaires combining daylight and dynamic electrical light. This paper explores a new universal design approach for supplementing the qualities of natural dynamic light by boosting it with dynamic LED light integrated into the window.*

*A qualitative experiment was carried out by integrating controllable LED in the frame of a façade window in a full-scale mock-up. It was observed how this set-up could support the colour spectrum and intensity of the daylight intake during the transition time from daylight to darkness.*

*The findings illustrate that a “luminaire window” has the potentials of meeting people’s natural need for contact with nature, enhancing the architectural potentials of the space and supporting the circadian rhythm. This is achieved through a double dynamic illumination layer in the interior space without limiting the daylight intake. New research directions are defined, combining knowledge on dynamic light from healthcare, engineering, neuroscience and architecture through transdisciplinary experiments. These experiments should be carried out in healthcare environments, based on user experience and patient outcomes.*

# Introduction

The dynamic, unpredictable and yet recognizable daylight changing over the day and seasons has through history been recognized as one of the most powerful formgivers in architecture. Great architects have always understood its importance as the principal medium, which puts man in touch with his environment (Lam, 1977). Parallel with the rapid development of adaptive lighting technologies, the importance of dynamic light to support health and well-being has been more and more recognized (Lam, 1977; Veitch, 2011; Boyce, 2014; Johnstone, 2015). People in healthcare environments have a specific need for optimized daylight conditions due to limited access to outside spaces and stress- and pain-related conditions. Especially the elderly and caregivers who work on day and night shift, often have a need for regulating their circadian rhythm, through circadian light.

Daylight penetration through window openings is crucial for stimulating the circadian rhythm and, therefore, for maintaining a healthy sleep-wake pattern (Johnstone, 2015). At the same time, the window can provide a pleasant view and connection to the surroundings, and enhance the perception of the interior space and materials (Veitch, 2011; Hansen & Mullins, 2014). All three factors are recognized as important for human well-being and health but, nevertheless, they are seldom considered in a holistic lighting design (Hansen, Gylling & Mullins, 2013).

The daylight intake in our buildings is not always optimal to meet human needs. We spend 90% of our time indoors where the daylight factor is often limited to the 2% required by standard. In countries at the northern latitude, like Denmark, the lack of daylight in the winter period and the lack of darkness in the summer is another challenge met by people, who need the natural light and darkness to support their daily, or circadian, rhythm. The interest in using daylighting design to benefit building occupants has, according to Veitch (2011), never been higher. According to the 2004 CIE report (Commission Internationale de l'Eclairage), five principles of healthy lighting can be stated:

1. The daily light dose received by people in Western countries might be too low.
2. Healthy light is inextricably linked to healthy darkness.
3. Light for biological action should be rich in the regions of the spectrum to which the nonvisual system is most sensitive.
4. An important consideration in determining light dose is the light received at the eye, both directly from the light source and reflected from the surrounding surfaces.
5. The timing of light exposure influences the effects of the dose (Veitch, 2011).

As LED technology evolves, electrical light becomes digitally controllable and programmable; designers are taking advantage of the unprecedentedly small-sized light sources, creating radically new fixtures and integrated designs (Johnstone, 2015). The artificial light can now support our cultural as well as biological needs. Even daylight can be simulated. In being able to control the intensity, direction and colour spectrum of electrical light sources, there are potentials regarding both functional and aesthetic aspects. The Lighting industry is developing light sources to meet these needs, such as Philips HUE, 'wakeup' lamps for private homes, and advanced lighting for

improving recovery in hospitals as well as improving the learning environment in schools (Johnstone, 2015).

Daylight and electrical light have by tradition been treated as two separate light sources, where the electrical light often has been defined in quantitative terms to fulfil a defined task and regulation. The new intelligent and dynamic light sources are therefore often added to the architectural context, not as an integrated part of the main light source, the window. These new technical possibilities need to be integrated into an architectural understanding of light, space and people's needs.

Why not take the departure from the main provider of light - the window - and use the dynamic LED technology to adapt the daylight colour, intensity and direction and the potentials for boosting the light, to meet people's biological and cultural needs for "natural dynamic light"?

Imagine a luminaire window which during the winter mornings supports the room with the light of sunrise, extending the daylight hours and enhancing a cold November day with warm light, as if it was a sunny day. Imagine a window being a light source which supports the users' changing needs for concentration and relaxation, and is at the same time stimulating their circadian rhythms. The luminaire window will support the connection to nature by enhancing poetic natural phenomena in nature such as extending "the blue hour" or creating brilliance in the raindrops falling on the glass.

The first author has been engaged in designing, building, testing and analyzing a building where the windows are valued for their positive impact on the following parameters: 1) expression of space and materials evoked through daylight; 2) indoor and outdoor relations; 3) functional daylight conditions; 4) fresh air and comfortable temperature and 5) solar heat gain. It was verified that the window as a design element can be used both as a poetic device and a technical tool to improve quality of life in buildings (Hansen, Gylling & Mullins, 2013).

Through integrating dynamic adaptive LED technology and knowledge on biological needs, we rethink the window to be a lighting fixture which transmits and reflects light – a double dynamic window and a powerful "formgiver". A multidimensional design element in our built environment (Hansen & Mullins, 2014), supporting our visual as well as non-visual needs for natural light and darkness and through combining knowledge from the fields of architecture, neuroscience and adaptive lighting design and technology.

To enhance this holistic approach to the window, the following three potentials of the window defined by Vietch (2011) are used in this experiment:

1. Contributing to support the circadian rhythm.
2. Providing a view to the outdoors and thereby a contact to nature.
3. Influencing the appearance of the interior space.

In this paper, it is discussed how dynamic LED light can boost the qualities of the window and thereby support these three potentials. The three potentials are described and they are then used to structure the observations obtained from the experiment.

### **Support for the circadian rhythm.**

During the past 15 years, neuroscience has proved that light is not limited to the mediation of vision; light has an important non-visual effect (Boyce, 2015). The light hitting the eye will affect the ganglion cells, which affects our production of melatonin and cortisol. These hormones synchronize all physiological events over our 24-hour cycle, most notably our sleep-awake cycle – the circadian rhythm (Boyce, 2014). The cells are most sensitive to short wavelength optical radiation (blue light) and rhythms of light and dark, which

means that a new non-visual design parameter using light to achieve a healthy lit environment can be integrated into lighting design (Boyce, 2014).

According to Boyce (2015), though much work remains to be done, we do know that shift workers, people crossing time zones or those with damaged circadian rhythms can be supported by light. Alertness in the morning can be stimulated by blue light and in the evening melatonin can be stimulated by eliminating blue colours, using warm colours and darkness. There is, according to Boyce (2015), still a lot to learn about this human centric lighting. But the effect has been well documented and a new unexplored field within designing with light has begun.

### View and contact to nature

In "Perception in Lighting as Formgivers in Architecture" Lam (1977) describes the importance of the natural daylight in relation to the artificial light, by defining how light meets human beings' needs through supporting both the activities we engage in and our biological needs. These positive biological needs for visual information Lam defines within design criteria as orientation, security, relaxation, adjustment to the biological clock, contact with nature and definition of territory. This effect of light is based on the strong visual effect of natural light connecting us to nature through an evolutionary understanding of daylight, time and context (Lam, 1977).

Virtual windows as the CoeLux ("Experience the sky", n.d.) window have been developed where the daylight colours, direction, and intensity can be simulated. But the daylight intake from the window is not just the light. Research has established that a connection to nature through a view is beneficial for hospital patients, who recover more quickly if they have a view of nature (Frandsen et al., 2009). Lars Brorson Fich (2011) has investigated how the openings as part of the architectural design could contribute to comfort and well-being. The results show that openings in themselves can influence physiological stress reactions and, as stress has long been known to influence the immune system, consequently a person's health and physical well-being (Fich, 2013).

The visual effect of a view of natural light is a strong tool in art, as well as in architecture. Significant in this regard, the artist James Turrell explores the view of the sky through openings in the ceiling. The blue of the sky is contrasted against the warm white light of the interior – framing the skylight. The light installations "Skyspaces" enhance the change in daylight intensity, colour as well as the intensity of the piece and create openings where the perception of the sky is explored as magic light spaces between sky and earth – a skyspace is imbedded into the architectural structure – the working of space and colour – colour-light-space combinations (Noever, 2001).

### Appearance of the interior space

The daylight intake has a strong influence on the appearance of the interior space. The distribution of light and the variation of direct sunlight, reflected light and diffused skylight creates different experiences of the space, materiality, and objects relating to occupants' preference to natural light. The Danish painter Vilhelm Hammershøj (1864-1916) is today highly recognized for his poetic and minimalistic paintings illustrating spaces in his home in Strandgade in grey scales, lit by a small amount of light often from a single window. The poetic capturing of how the light in a moment is playing in space and materials is fascinating us. Architects have through history explored how light creates space and atmosphere through the main light source, the window opening. The poetry in the light changing over the day and seasons has a strong architectural effect connecting occupants to nature. A rethinking of the window as a combined natural and electrical light

source – a combined window and lighting armature - opens for possibilities to enhance the classical architectural understanding of the window as the main provider of light, and how the dynamic light can transform spaces, objects and textures over time.

## The luminaire window

Integrated LED lighting has been used in retail store windows and also for art projects in frames. In these cases, the coloured LED illumination has merely decorative purposes. In private homes, a string of white LED lights has been used as an enhancement, creating vibrancy on the glassed balcony by integrating the light into the upper and lower track. In all these cases the light is considered as a traditional light source supporting the space with light when there is no daylight. The LED light is causing glare and it is not considered how the lighting can be a building integrated luminaire that can respond to the natural light intensity, colour or direction to improve the circadian rhythm, the view and at the same time the appearance of the interior space.

Considering that natural daylight is the main light source, and that the quality of the view is an important constraint for integrating light in the window construction, the light source must not limit the daylight intake nor the view. This means that the lighting technology cannot be integrated in the glass or in front of the glass. To avoid glare the LED has to be covered with a diffusing lens. The frame, sash and glass, as well as the lining, must reflect and distribute the light to reach an even light distribution to simulate the light transmitted through the pane.

In the experiment described in this paper, the potentials of boosting the daylight from the window are tested by integrating a dynamic LED light source in the top of the window frame, to make the light come from above, like daylight. It is investigated whether it is possible to support circadian rhythms, to enhance views and contact to nature, and to create an even light distribution in order to influence the appearance of the space and boost the experience of the daylight intake.



# Method and Materials

The potentials of a dynamic LED light integrated within the window construction were investigated in the following experiment through photo-analysis using a full-scale mock-up. Through qualitative methods, the following questions were posed:

- 1. How can the luminaire window support a circadian rhythm?
- 2. How can the luminaire window provide a view to the outdoors and thereby contact to nature?
- 3. How can the luminaire window influence the appearance of the interior space?

First, a time-lapse was taken during the transition period. In this context, it was observed how the LED light can support the daylight intake during the daytime, the transition hours and during the night time. It was observed how the light is distributed in the window glass and frame as well as in the space and how this light affects the interior space and the view through the window.

In each case, besides making notes, photo records were the main form of documentation. For the photography, a Canon EOS 70D camera and a fish-eye lens (180° angle of view) was used. Each series was taken with the same camera settings (Table 1). These pictures were analysed later through comparison.

Table 1. Camera settings

ISO speed	ISO-400
Exposure time	1/15 sec.
Metering mode	Partial
Flash mode	No flash, compulsory
Focal length	5 mm

## The test space

The test space for the experiment was a 2.100 x 2.440 x 2.400 mm wooden mock up placed in the parking area of Aalborg University Copenhagen (55°38'57.0"N 12°32'31.7"E) (Figure 1.)

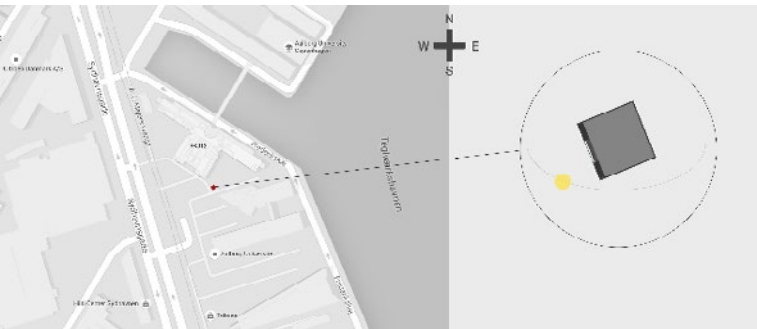


Figure 1. Position of the mock-up

The inside walls of the mock up the ceiling, and the floor are painted matt white. The mock-up included a window from the VELFAC200 window series provided by Dovista A/S, facing south-west (Figure 2). The dimensions of the window are 900 x 1200 mm. The pane is a standard three-layer pane of

three 4 mm thick glass sheets with 18 mm of gas-filled space in between the sheets and coated on side 2 and 5 respectively.

On the top frame of the window, a tuneable-white, single row, LED strip, provided by Simpight, was integrated into the internal side of the window frame (Figure 2.). The actual colour temperature of the light – the ratio between the two LED types – was controlled by a Raspberry PI, and could vary between 2.400-6.500°K. The colour rendering index (CRI) of the light source was 90+. The brightness of the strip was 635 lumens/meter (2.400°K) and 753 lumens/meter (6.500°K).

In order to avoid glare, a diffuser lens was applied on the top of the LED strip.

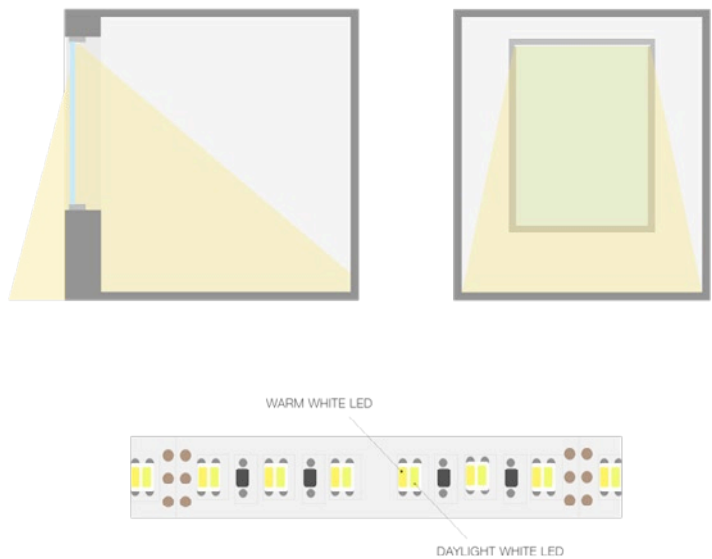


Figure 2. Adjustable LED strip built in the window in a mock-up

## Procedure

The time-lapse photo series was taken on the 5th of October 2015 from 15:45 to 19:15. This period of time covered the end of daytime and the civil twilight, thereby a range between daylight and almost total darkness was observed (Figure 3). The sky on that day was partly cloudy.

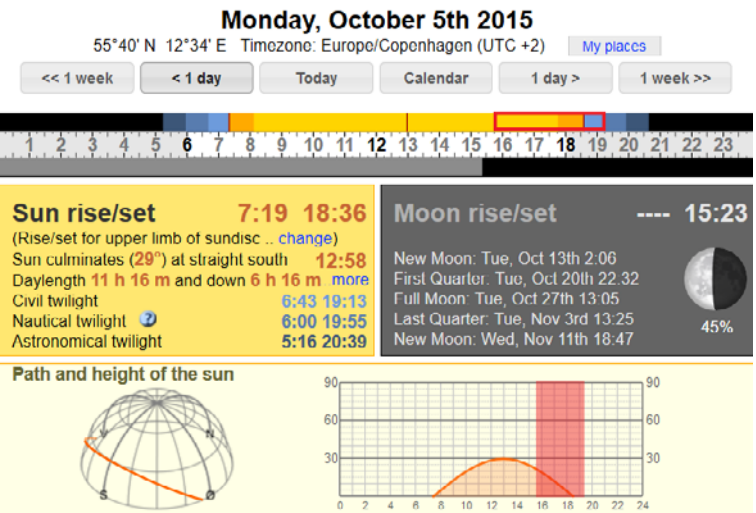


Figure 3. Data about the sun movement on the day of the test

Three photos were taken every ten minutes: one with only natural light, and two with electrical light support. The LED strip was programmed to switch between no LED light, 2.400°K and 6.500°K. The three pictures were taken with these end values.

In this experiment, twenty sets of three photos (photo-trios) were produced and analysed.

## Results and Discussions

After the photo registration, each photo-trio was analysed in regard to visual qualitative observations of how the LED light influenced the daylight within the three criteria.

### How can the luminaire window support the circadian rhythm?

During the daylight hours, the artificial light had no visual effect on the light conditions in the test space due to the high level of daylight. At 16:20, the artificial light became noticeable. After this point, in relation to the natural light, each colour temperature had a different impact (see Figure 4). Before the start of the blue hour, which was around 18:00, the cooler colour temperature had a boosting effect on the natural light intake. This supplement to intensity and colour temperature created a feeling of daylight even when it already started to become dark outside, which indicates potentials in lengthening the day in the winter months, and in accordance with the rhythm of the biological clock (see Figure 4).

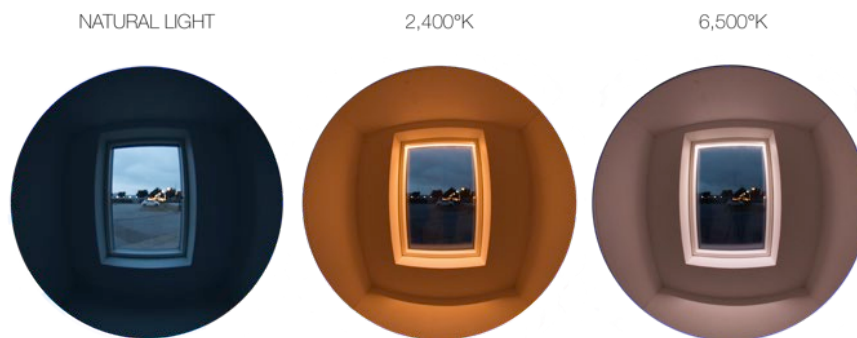


Figure 4. The photo-trio has been taken in the same time with different CCT of the white LED light

In the last hour of the experiment, the warmer colour temperature was perceived to be more pleasant, which can be an indicator that supplementing the light with warm light can meet psychological and biological needs for warm light in the evening. The relation between the time and the colour temperature is shown in Figure 5.

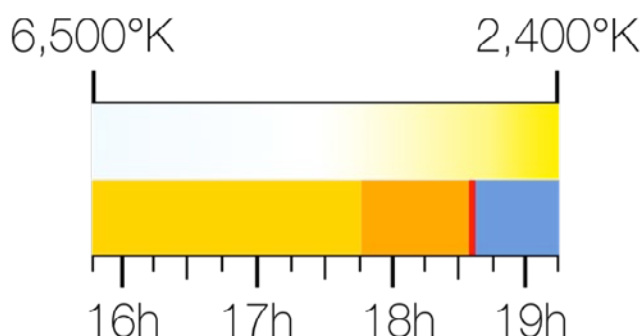


Figure 5. Relation between the time and the colour temperature of the LED strip and of the daylight

As an additional observation, it was also noticed that when the sky was cloudy during daylight hours, the warmer colour temperatures gave a sensation of sunshine. This means that certain colour temperatures could create a feeling of warm sunlight on an overcast day.

The experiment illustrates potentials of meeting biological needs and supporting the circadian rhythm. It indicates that alertness in the morning can be stimulated by cold LED light in the window, and in the evening you might stimulate melatonin production by eliminating cold colour temperatures and using warm colours instead.

## How can the luminaire window provide a view to the outdoor and thereby a contact to nature?

The photos illustrate that the integrated LED light does not limit the view to the outdoors (Figure 6). In Figure 4 it is demonstrated that warm light enhances the perception of the dark blue sky – the blue hour – with references to James Turrell's lightscapes (Noever, 2001). There are potentials in creating contrasting colours to enhance the sky's light, thereby creating perceptions of natural phenomena of changing light and context.

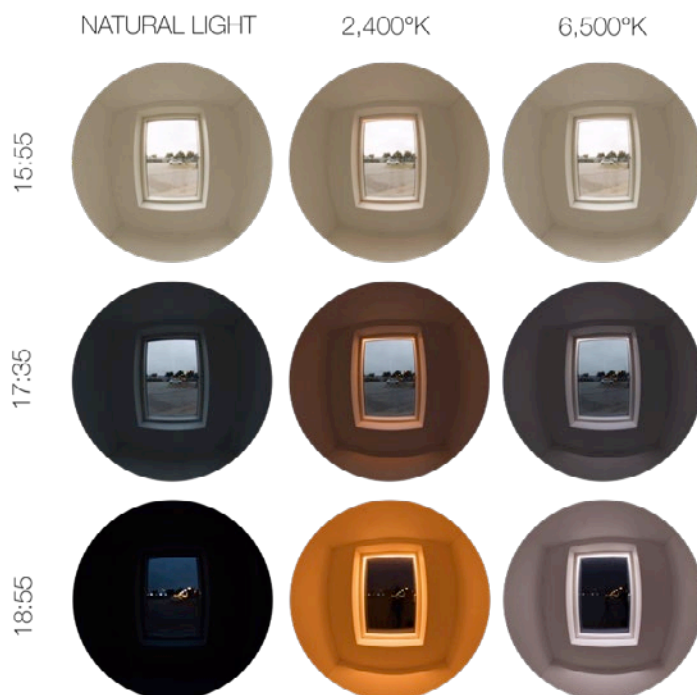


Figure 6. Light distribution in the room in different times and with different colour temperature

## How can the luminaire window influence the appearance of the interior space?

Besides the colour temperature, light's distribution was also investigated in the space. Observing the distribution of the daylight in the room at around 16:00 and the distribution of the LED light at a later time, around 18:00 (when there was no daylight), it can be concluded that the distribution of light was surprisingly similar in both cases (Figure 7.) The window itself and the white walls reflected the light in a very similar way: the strongest highlights were around the window frame and on the floor, while the reflected light on the walls was more diffused. On the ceiling above the window, a relatively bright highlight reflected from the floor and the window sill. The contrast with

the environment was relatively low, except in the case of the floor highlight, where the cast shadow of the window created a higher contrast. It is observed that one strip of light in the top window frame can distribute the light relatively evenly. The window becomes a reflector of electrical light – a luminaire, which indicates interesting design potentials for the window of the future, not only optimized to distribute the daylight intake but also to distribute the electrical light.

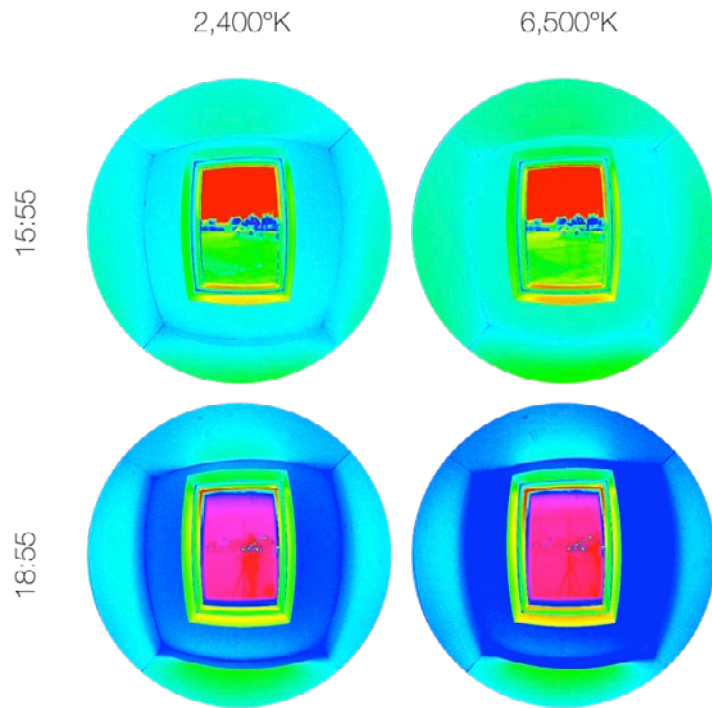


Figure 7. Light's distribution in the space in a false colour image, illustrating the similarity of the light when it comes from daylight (15:55) and only from LED integrated into the top frame of the window

# Conclusions

The findings from this pilot experiment, concerning the design and testing the concept of a luminaire window, illustrate that dynamic LED light integrated into the top of a window has potentials to meet human needs for light supporting circadian rhythm, enhancing the contact to nature, and at the same time creating an even and natural light distribution in the interior space, boosting the daylight without limiting the intake.

The observations of the light scenarios demonstrate that the LED light, which is boosting the daylight, can be reflected within the window pane, frame and lining, and can thereby create an even light distribution without causing glare.

- It is possible to extend the daylight hours through LED integrated into the window, as well as to boost the colour temperature and thereby supporting the circadian rhythms.
- Cold daylight on an overcast day can be boosted with warm LED light which would thereby create a warmer experience of the daylight.
- The integrated LED light can support the view by creating a contrasting colour to the sky's light.
- The light from one single LED strip integrated into the top of the window frame can be distributed into the room, imitating the sky's light transmitted through the window during daytime.

With these findings, it is relevant to continue research within how combined daylight and dynamic LED light, double dynamic light, can meet individual needs in healthcare and in other built environments.

There is a need for basic research to define the architectural and scientific design parameters for the combined light, where daylight is considered as the main light source and where integrated LED light is boosting this by responding to the daylight conditions and patients' needs for biological and architectural stimuli. There is thus a need to combine the fields of knowledge from architecture, healthcare, neuroscience and light technology. Knowledge on transdisciplinary design processes can be developed by illustrating how light within these fields can be combined in a process model "The architectural experiment" developed by the author as a tool to design with knowledge of light, a multidisciplinary design element (Hansen, 2013). Towards this end, experiments can be setup to combine and develop new knowledge on double dynamic lighting design employing scientific definitions of how lighting meets our needs. New criteria for lighting in different healthcare contexts can be created, and it can be verified how these criteria can be met by integrating new responsive LED technology in the luminaire window.

Suggested research directions to be investigated to develop the concept of "luminaire windows" in healthcare:

- Potentials for reducing energy usage and carbon emissions in health care in response to rising standards for energy efficiency can be an investigation of how LED light in the window can extend the "daylit hours" responding to daylight conditions and patients' needs.
- New potentials in architectural lighting in healthcare can be identified by defining natural light phenomena and how to explore these in the space

by combining daylight and dynamic LED, framing the view, creating contrast to the natural light and illuminating the space.

- Investigation of how boosted daylight can support everyday tasks in different contexts of healthcare; how the luminaire window can respond to different contexts to meet different peoples' needs, such as the elderly, children, patients' needs for healing in hospitals, different treatments etc.
- The light technology must be developed and sensors programmed to respond to the daylight parameters and different needs in different context.
- Health and biological needs must be defined through lighting design criteria that can be supported by the luminaire window.

This work requires a mixed method approach where qualitative and quantitative tests are conducted in mock-ups, scale models, in daylight and in virtual light labs connected to user experience and patient outcomes.



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# How to evaluate healthcare buildings? Selection of methods for evaluating hospital architectural quality and usability - a case at st. Olavs hospital in norway

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**Aim:** Architectural design of hospitals can be supported by a comparison between different spatial design solutions and evaluation of best practice. This paper reports from a research project developing a set of evaluation methods for hospital architectural quality and usability, including patient and staff experience. The aim is to connect usability to the discussion on architectural quality of hospitals and provide data and tools for future hospital projects.

**Background:** There is lacking a method combining the evaluations of physical spatial architectural layout, architectural quality and usability, assessed by medical staff, patients and hospital architecture experts.

**Methods:** Many evaluation methods deal with architectural quality and usability, but only few are specifically designed for hospitals. Rather than testing many full evaluation methods in healthcare environments and risking repeating procedures, parts of different methods that seem to cover different topics were chosen. The approach is a pilot project, with selected seven evaluation methods/tools, that potentially should give a full picture on *hospital architectural quality and usability*. This research is the first step in developing a set of tools for evaluating hospital architecture and usability most thoroughly. It was conducted as a best practice case study at one ward at St. Olavs Hospital in Trondheim, Norway. This approach tests more methods on one ward to compare the process and results of the chosen evaluation methods and save the scarce resources of the hospital.

**Results:** A set of seven evaluation methods are compared on objectives and results for the development of a new set of methods for evaluation of hospital architecture. Additionally, the preliminary results from five methods for evaluation of architecture at the ward are presented. This can assist further improvements of existing facilities, or development of programmes of requirements for new hospitals, based on evidence from cases.

**Keywords:** evaluation, usability, hospital architecture, users

## Introduction - background and aim objective

Architectural design of hospitals can be supported by a comparison between different spatial design solutions and evaluation of best practice cases and simulations. Few evaluation methods are specifically designed for hospitals, but many include relevant techniques. There is lacking a method combining the evaluations of physical spatial architectural layout, architectural quality and usability, assessed by medical staff, patients and hospital architecture experts. This paper reports from a research project determining indicators that make it possible to assess different architectural layouts, patient and staff flows, and user experience. Rather than testing many full evaluation methods in healthcare environments and risking repeating procedures, parts of different methods that seem to cover different topics were chosen. The aim is to connect usability evaluation to the discussion of architectural quality of hospitals and provide data and tools for future hospital projects. Therefore, this paper takes a step towards the development of a new set of methods for evaluation of hospital architecture and usability.

# Evaluation methods for buildings

The most known evaluation methodology for buildings is *POE – Post Occupancy Evaluation*. According to the definition of Preiser et al. (Preiser et al, 1988; Preiser, 1989; Preiser, 1995), Post Occupancy Evaluation is "the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time". Traditionally POE is carried out by trained professionals or researchers with background in social sciences or workplace consulting.

As building performance and usability assessments are complex, they require multi-method strategies using a triangulation of methods and evaluations with multiple perspectives (Lindahl, Hansen, Alexander, 2012). Further research showed that hospital projects use various evaluation methods for different reasons (Fronczek-Munter, 2013). Newest research sees POE as "one of the suite of tools to measure building performance and should be used in conjunction with other methods to evaluate all aspects of a building, including the social, psychological and physical" (Deuble & de Dear, 2014). They suggest a combination of objective building performance data and subjective satisfaction ratings to achieve a valid and reliable evaluation of a building.

There are over 150 POE techniques available worldwide (Blakstad et al, 2008; Bordass, 2006; Bordass & Leaman, 2005; Leaman, Stevenson, & Bordass, 2010; McDougall et al, 2002; Stevenson & Leaman, 2010). The numerous existing methods often have one focus area that is evaluated more accurately than others. That fact is shown in *Evaluation focus flower model* (Fronczek-Munter, 2013), where many of the existing evaluation methods for buildings have been mapped according to their main focus.

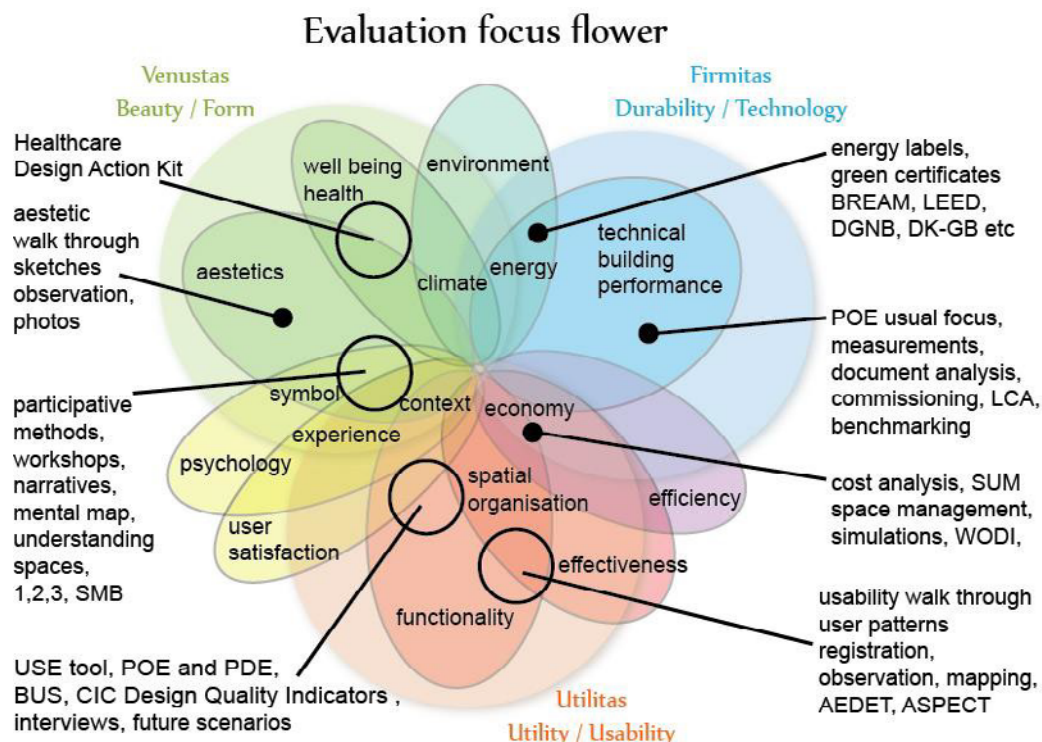


Figure 1 Evaluation focus flower model (Fronczek-Munter, 2013), with examples of evaluation methods and their main focus

Figure 1 provides an overview of some of the evaluation methods, grouped and placed on the *Evaluation focus flower* model, in order to easily find the right evaluation method fitting the focus area to study. The focus areas are represented as flower petals with overlaps. The model background are three main areas, that are based on three qualities of architecture, as defined by Vitruvius (80-15 BC) The qualities are: firmitas, utilitas and venustas. The understanding of the terms is not universal, in this paper Venustas is translated as Beauty / Form, Firmitas as Durability / Technology, and Utilitas as Utility / Usability.

The three main themes are further divided into more detailed focus areas. Further focus areas for evaluation of beauty are following: aesthetics, symbol, experience, context, psychology, well-being, health, climate. Focus areas related to technology are: technical building performance, energy, environment, efficiency, economy. Focus areas related to utility are: usability, functionality, spatial organisation, effectiveness and user satisfaction.

## Methodology / approach

Few evaluation methods are specifically designed for hospitals, but many of them include similar techniques. We decided to use a pilot project approach, where we selected seven evaluation methods/tools, that we believe will together give a full picture on *hospital architectural quality and usability*, see Figure 2 and Table 1. In order to map the topics that should be covered, we used the *Evaluation focus flower model*, see Figure 1 and searched for methods to cover all areas, see Figure 2. This approach could be the first step in developing a new set of methods for evaluating hospital architecture and usability most fully.

### Evaluation focus flower and 7 evaluation methods

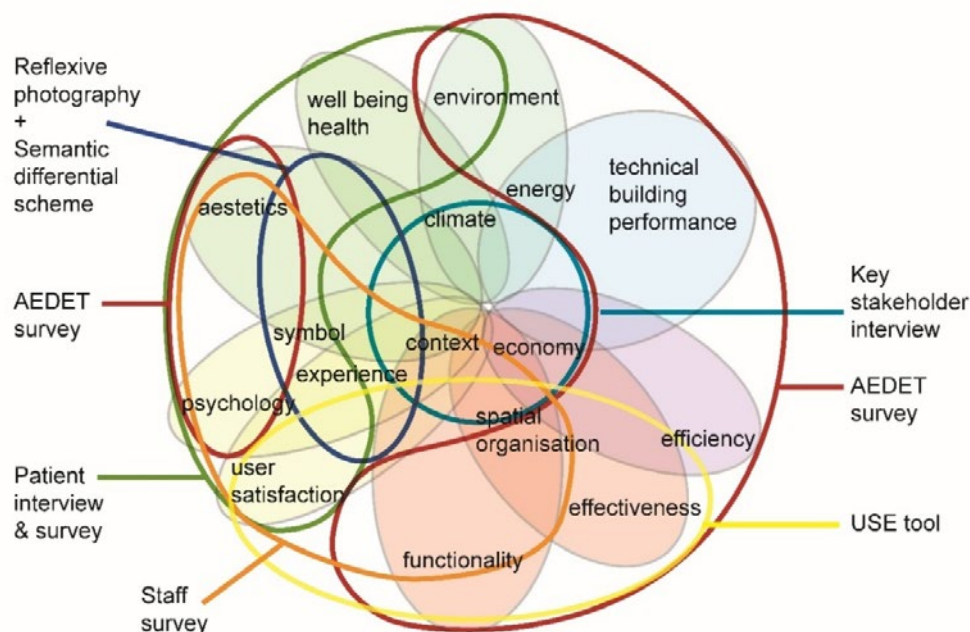


Figure 2 Mapping of the chosen seven evaluation methods, covering most areas on the Evaluation focus flower model

The research was conducted as a case study of best practice, where we tested the different methods in one ward – the Rehabilitation center (Nevro Øst) at St. Olavs Hospital in Trondheim (Norway). It is a new regional university hospital built in the years 1994-2014. The hospital qualifies as a case study of best practice from an architectural perspective, because it received seven awards at Design & Health International Academy Awards in Toronto, Canada in 2014, including an overall winner of international health project over 40.000 m<sup>2</sup>.

Rather than testing many full evaluation methods for healthcare environments to compare the results, but risking many repeating procedures, we chose parts of different methods that seem to cover different topics. We tested several evaluation methods at the same location, in order to compare the process and results of them, and propose choosing the most efficient set of methods, covering a full range of hospital architecture aspects, for future hospital policy and projects. In this way we compare the results of a set of evaluation methods, before we apply the same procedure and test the methods in other wards or hospitals. We decided for a pilot project and evaluate a single ward, not to spend the scarce resources of the hospital unnecessarily. Additionally, the rehabilitation ward gives an advantage, as a first pilot test setting of methods,

because of availability and longer time the patients spend in this ward, which will enable them to answer research questions while they are staying at the hospital.

## The selection of the seven evaluation methods

In order to find the evaluation methods, that will be most proper and relevant to give a full picture on architecture quality and usability of healthcare buildings, we started with a previously published literature review on existing building evaluation methods (Fronczek-Munter, 2013). We particularly looked for methods that are applicable in healthcare buildings and that can be used to evaluate both buildings that have been completed and taken into use, as well as building projects. In addition, we looked for recent POEs of hospital wards (Maben, et al.) and searched for other specific methods to add. We found that many methodologies consisted of multiple methods/tools to combine, and that some of the methods are very similar. We decided to include the most appropriate and promising selection of methods, to cover most of the themes from the *Evaluation focus flower model*. We looked for the questions being addressed and typical results from existing methods, then mapped them on the *Evaluation focus flower model* and searched for methods to cover the missing parts. The mapping of the methods and their focus can be seen in Figure 2. The selected seven methods are summarised and compared in Table 1.

Four different methods were picked from one recent publication about evaluating single room hospital design (Maben et al., 2015), marked with \* on Table 1. The background of this study was that new hospital design includes more single room accommodation but there is scant and ambiguous evidence relating to the impact on patient safety and staff and patient experiences. Therefore, the objectives were to explore the impact of the move to a newly built acute hospital with all single rooms on care delivery, working practices, staff and patient experience, safety outcomes and costs. The research design was consisting of three parts with several methods in four case study wards and control hospitals.

This paper has a much smaller scope with a pilot project approach. Therefore, we pick four relevant methods from this publication (key stakeholder interview, staff survey, patient survey, staff reflexive photography) and test their suitability to evaluate architectural quality as separate methods. The other three methods (AEDET, USE tool, semantic differential scheme) are chosen from other publications to achieve most relevant collection of evaluation methods.



Figure 3 Evaluation research at Nevro Øst, studying the ward layout, AEDET method



Table 1 Selection of tools/methods from various sets of evaluation methodologies, chosen specifically for evaluation of hospital architectural quality and usability

Evaluation method	Method description, How to use it?	Results	Participants, needed items and time
<b>Key stakeholder interview</b> *, generic	Qualitative in-depth interviews with key stakeholders, understanding of challenges and experiences	In-depth insight from client organisation relating to outcomes from hospital design	Medical director, clinical planner, programme manager, builder, architect, director of nursing, director estates and facilities, ward manager, 1h each
<b>AEDET Evolution survey</b>	Expert assessment, 10 topics: IMPACT: Character and innovation, Form and materials, Staff and patient environment; Urban and social integration; BUILD QUALITY: Performance, Engineering, Construction; FUNCTIONALITY: Use, Access, Space	Evaluating the quality of design in healthcare buildings. Strengths and weaknesses of a design or an existing building.	Architects, hospital facility managers, staff and other professionals Floor plans, 1h
<b>Staff survey *</b>	Staff survey – Impact of hospital ward design on staff experiences - questionnaire survey	Data /evidence relating to hospital design and staff experiences	Medical staff, ie. nurses, 20 min.
<b>Reflexive photography *</b>	Staff- reflexive photography (adding interview or combine with questionnaire, ask for narratives, explanations, short stories)	Examples of weak and successful solutions in hospital architecture	Staff, 15 min, photo camera, notes
<b>Semantic differential scheme</b>	Scheme with 8 parameters, i.e.: complexity, originality, pleasantness – people's immediate experience and evaluation of places, comparisons, beauty, psychology	Impact of hospital ward design on user's experiences, understanding people's subjective experiences of hospital spaces, beauty and well-being	Intuitive scheme about own experiences, 5 min.
<b>Patient- interview &amp; survey *</b>	1 hour interview with survey , questions specially designed for single patient rooms hospital projects	Data /evidence relating to hospital design and patient experiences	Patients, 1h
<b>USE tool walk-through -mapping usability</b>	Usability evaluation with user perspectives, here 3 stages: Defining the evaluation scope, Usability walk-through, report -summary of findings; observations and discussion with users	Evaluation of the usability of the premises from user perspectives, observation, but not shadowing	Managers, building project groups, floor plans, walk through building, 1,5 h

\* - part of publication of Maben, et al (2015)

# The description of the evaluation methods and their results

In this section, the seven chosen evaluation methods are described. The preliminary results are presented for five methods and the expected results for two scheduled methods, that are not yet completed.

## Key stakeholder interview

Key stakeholder interview is a generic method, which is also proposed by Maben, et al (2015). The results are in depth insight from the hospital organisation relating to outcomes of the hospital design. The focus areas covered best were expected to be more strategic, shown closer to the centre of the Evaluation flower model, and include: economy, spatial organisation, context, experience.

We interviewed 13 key stakeholders, which included: current and former board members (3); members of the former project organisation (3); user coordinators involved in the design process (3) and; heads of clinics of the current hospital organisation (4). The interviews were semi-structured by using a topic list. During the interviews, notes were made and the interviews were recorded with a voice recorder as well. Based on the notes and voice recording, a summary was written and sent to the respondents for approval.

The interviews with board members provide insight into the various strategic aspects involved in decisions on architectural or process-related interventions. Asking the same question to stakeholders at different levels within one hospital provides insight into the impact of the building on healthcare processes. Interviewees were asked: (1) what they would describe as the main architectural qualities of the St Olav's Hospital; (2) how the building contributes to a positive interaction between the healthcare professional and the patients and; (3) how and where the architecture has an impact on the clinical process. Interviewees were also asked to describe a specific place where the building does not support, or even disturbs efficient healthcare.

Most of the stakeholders described the high architectural qualities of the whole hospitals design and the specific solutions in form of centre structure and only single rooms for patients and the concept of "*sengetun*" – a unit at department level with open decentralised working stations for nurses and supplies. The units consist of 24 beds, including 3 *sengetuns*. The *Sengetun* is an example of how the architecture supports the ideas of how people will work in a hospital of the future, how patients and relatives act. The single patient rooms are a good example of the high architectural quality for the patients, with views outside through the windows, pictures on the wall and the use of colours. Interviewees described also the changed working pattern and social changes in privacy and visibility, from closed staff areas to closed single patient rooms and open nurse stations, which is admired by the majority of people. Some of the stakeholders also mention the quietness, as a result of smaller units and single beds. '*You do not see the business that you saw in the old hospital, when you walk through the hospital, it is quiet.*'

The interviewees' perception of good architecture is that it consists of things difficult to describe, about an atmosphere, the impression of harmony that consists of all the details. It concerns the combination of beauty, functionality and sustainability: it should be pleasant to look at; good functionality and last for

some years, i.e. sustainability and solidity. But it is also about feeling, how the building makes you feel by the colours, daylight, nature and art. Most people say the hospital is nice, bright, and light; it is a pleasant place to be. Concerning this irrational, emotional part of architecture it is important that the hospital gives you a feeling of being welcome and included. The design tries to find a balance between the raw functional demands, logistics and infection control, which sometimes makes it hard to consider patients' wellbeing. Part of the architectural quality of the hospital is the relation with the landscape outside, but also excitement and surprise: *'I like the ability to be surprised in a positive way'*. Most of the interviewees describe the processes and complaints of personnel from the past to the centre model and open work stations, most of it not existing anymore. There are still a few problems, for example the X-ray department is spread between all the departments, and there is limited flexibility in the centre model, but in general people are pleased and proud of the hospital. One of the respondents described good architecture clearly as a combination of beauty and functionality, but added a critical note: *'Asking about the architectural quality is the beauty question, about the art and how much light enters through the large windows (...), that is quite good compared to other hospitals. But if you look to functionality, you see something else.'*

In general, the remarks from key stakeholders were both at a strategic level and specific experiences at a department level. Finally, in the Evaluation focus flower model the following topics were covered: spatial organisation, efficiency, economy, context, experience, aesthetics and well-being.

## Achieving Excellence Design Evaluation Toolkit

The AEDET Evolution toolkit (NHS, 2008), developed in the UK, is described as a benchmarking tool and evaluates a design by posing a series of clear, non-technical statements, encompassing the key areas of impact, build quality and functionality. According to Department of Health, UK (2013) "healthcare building design frequently involves complex concepts which are difficult to measure and evaluate". The AEDET toolkit is thought to be used by hospital (client) organisations determining and managing their design requirements from initial proposals through to post-project evaluation. At first glance, the ten sections promise to cover many areas at the *Evaluation focus flower model*: both aesthetics and psychology, technical performance, energy, effectiveness, functionality and spatial organisation.

AEDET Evolution has three main sections on following topics: Impact, Build Quality, and Functionality – split into 10 assessment criteria. Scoring these criteria assesses how well a healthcare building complies with best practice.

The AEDET Evolution toolkit is built in an Excel spreadsheet with a survey, organised in the following sections (see also Figure 3):

1. **IMPACT:** Character and innovation
2. Form and materials
3. Staff and patient environment
4. Urban and social integration
5. **BUILD QUALITY:** Performance
6. Engineering
7. Construction
8. **FUNCTIONALITY:** Use
9. Access
10. Space



Figure 4 AEDET Evolution toolkit and its three sections

When planning the first evaluations with the AEDET tool, we studied the questions in detail in order to choose appropriate participants for the evaluation. They turned out not only to be “clear, non-technical statements”, but also include professional terms, that require both knowledge and access to detailed plans, data sheets and historical knowledge of construction. We provide a few examples:

The engineering systems exploit any benefits from standardisation and prefabrication where relevant;

The ratio of usable space to the total area is good; The circulation distances travelled by staff, patients and visitors are minimised by the layout

If phased planning and construction are necessary, the various stages are well organized

There are emergency backup systems that are designed to minimise disruption

Therefore, we chose our participants to be professionals. They were as follows: a director of the hospital facilities management organisation, a manager of nurses at the ward, a planner from the Norwegian advisory office for hospital building projects - Hospital Build HF (Sykehusbygg HF), two postdoctoral researchers in hospital architecture. Some of the participants did not know the building or its design and construction history, so we decided to visit the building and see the ward, and afterwards fill in the paper handouts of the questionnaire individually. Additionally, we asked two architects that were designing the building to join the common evaluation, but they decided to fill the questionnaire and send results by email, that gives a total of six answer sheets.

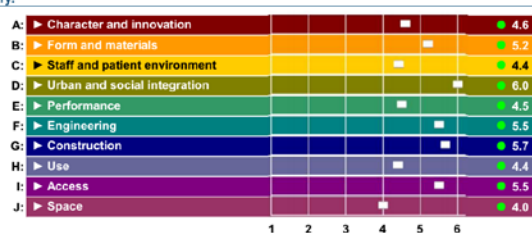
During the visit at the ward, we spent 1,5 hour in seeing all the rooms in the ward at 4th floor. It was longer than planned, not because of the vast amount of rooms, but because of the many discussions about the use of the rooms and both positive and negative impacts of layout, sizes and equipment, that were appropriate and inappropriate, according to the users. The nurses and room occupants felt the urge to share their stories with us. After visiting all public areas, most of the rooms for employees and typical patient rooms in two sizes, we filled the AEDET questionnaires.

The results are in general positive and in all the themes ranging between 3,6 to 6,0, see Table 2. The highest valued sections (from 4,0 to the maximum of 6,0) are the *urban and social integration*, which is in line with the hospital receiving international award on same topic. The section *staff and patient environment* also received high scores, between 4,4 and 4,9. Another high score went to *construction* (from 4,8 to 5,7), but majority of participants that could not answer the questions at all. The lowest score is for *performance* of 3,0 – which derives from the participant marking “little agreement” to “building is easy to clean”. Participants commented on the used wood and flooring finishes not being easy to clean.

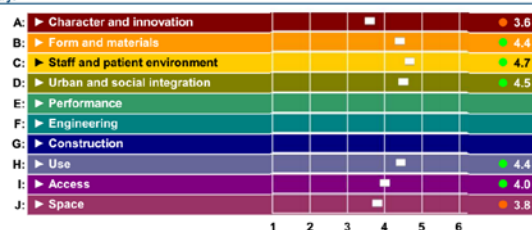
The section Space is also scoring rather low, between 3,8 and 4,3. The trigger for this result is a single question “There is adequate storage space” that was marked by all participants either 1- virtually no agreement with a comment “storage inadequate, beds in corridor, wheelchairs in corridor, blood samples in corridor!”, or highest: 2- hardly any agreement or 3 – little agreement. Most other questions in this section are scoring middle or high, most participants agree that “The ratio of usable space to the total area is good” and “The circulation distances travelled by staff, patients and visitors are minimised by the layout”.

Table 2 The results summaries from 6 participants of AEDET survey at NEVRO Øst

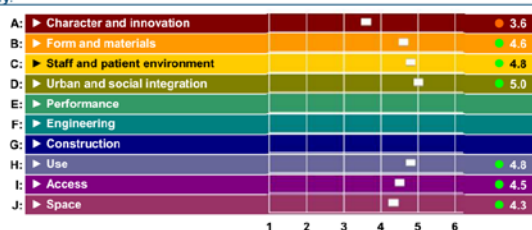
Results summary:



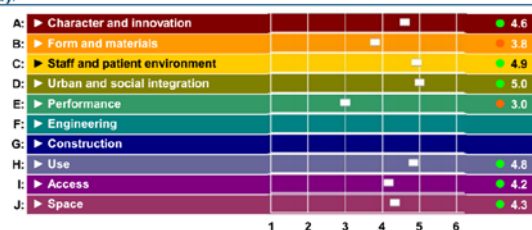
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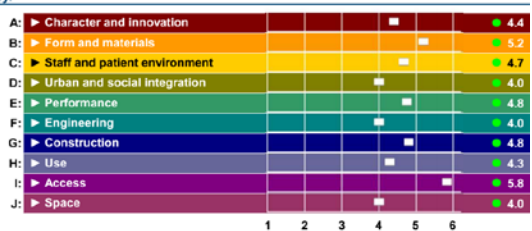
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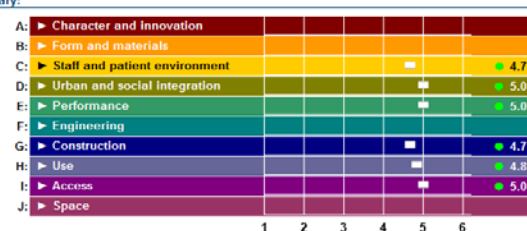
Results summary:



Results summary:



Results summary:



The first outcome category is the learning about the qualities of architecture at the ward. As the name suggests - Achieving Excellence Design Evaluation Toolkit, it has an aim to achieve excellent, best possible architectural design. The strengths and weaknesses of the design of the ward are made visible, organised in ten sections with average scores. The most positive aspects of the quality of architectural design at the Nevro Øst ward were belonging to sections *urban and social integration*, *staff and patient environment* and *construction*. The most negative score from the evaluation participants was in section *Space*, and specifically in the adequate storage space. In general, all participants were very positive about the architectural quality of the ward, having high standards for patients stay and pleasant work environments. Nevertheless, there were some areas, where the standard was much lower. We were surprised to see lots of cluttered equipment, beds, and even blood samples, stored in a corridor, accessible to public.

## Staff survey

This specific staff survey is developed for use with medical staff in single-bed hospital wards (Maben, et al, 2015). Expected results are the effect of design on staff experiences, work patterns, functionality, efficiency, effectiveness, satisfaction, and aesthetics. The survey does not include questions about well-being.

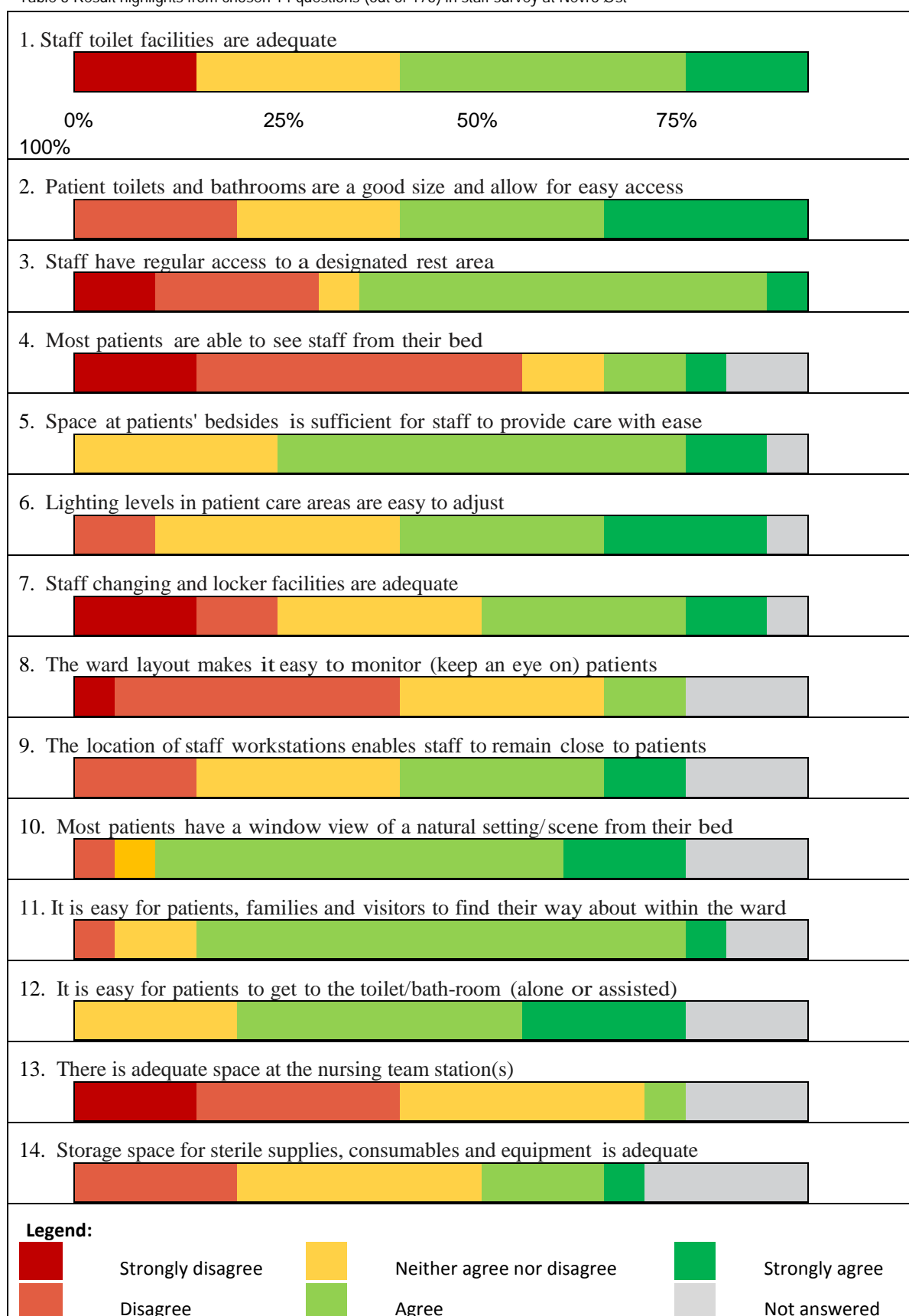
We made preliminary agreements with the management at the department about the scope, time and efforts needed to participate in this evaluation. The management was supportive towards the project and saw the potential of the results, but they were sceptical at first towards the size of the survey questionnaire. We decided not to shorten it, as one of the goals of this research is to test the methods, as they are. We did edit necessary details, as the names of the occupational titles and adjusted a few questions to fit the Norwegian working culture and for example job-shift times. Several users that filled in the questionnaire wrote in comments that it was too lengthy and they had to use several breaks at work to be able to fill in all the pages.

The survey was printed on paper, added an introductory text in Norwegian about the project and our invitation to voluntary and anonymous participation, and given to all 48 employees at the department in their personal work storage/mail box. The management sent email to all employees with their wish that many would participate in the project. The time to complete the survey was set to two weeks, later extended with one extra week due to extraordinary sick-leaves and high workloads. We prepared a separate locked post box for collecting the completed surveys, marked it with visible project name and placed it at the reception in the entrance area on the ward level. We received 19 answers, which is 39,6%.

The survey consists of five sections: 1. on layout, environment and facilities (74 questions), 2. on 100% single room versus multi-bed accommodation (29 questions), 3. recent shift on Nevro Øst (27 questions), 4. job satisfaction, teamwork and safety (32 questions), 5. background details (11 questions). In this paper, we present the preliminary highlight results from section 1, see Table 3. We will publish further analysis in a separate paper.

We present the results from 14 out of 173 questions in the staff survey. We chose the questions about layout and facilities that have high positive or negative scores. The vast majority agrees that three most positive aspects of the ward are: window view on nature for patients, easiness to find way for patients and visitors, and easy bathroom access for patients (questions 14,15,16). The three most common negative answers cover inability to see staff from patient's bed, layout obscuring view on patients for nurses, inadequate space at nursing team station (questions 6,12,21).

Table 3 Result highlights from chosen 14 questions (out of 173) in staff survey at Nevro Øst



## Reflexive photography

This method is generic and seen before in research and practice, but also part of hospital evaluations by Maben, et al (2015), proposed for hospital staff. Reflexive photography is a type of photo-elicitation technique where research participants take photographs – formed the focus of 'reflective' discussion. The approach allows the participant to talk about the significance and meaning of photographs, which represent their perspective on the topic in question. Reflexive photography can generate a visual record of the work environments and encourage research participants to critically analyse the ward layout, environment and facilities. It was used to prompt deeper consideration of positive and negative aspects of the spaces, and encourage participants to 'view' the architecture of it in a new way.

We applied this method in two weeks at the ward, providing a digital Polaroid camera with instant printing of the pictures on stickers. Instead of follow-up interviews suggested by Maben et al, we collect narratives – personal short explanatory written stories, combined with the photos. Additionally we added the next method- the semantic differential scheme, so this exercise was a merge of three different methods, that are simple and appear to cover multiple types of user input and better explanations and understanding. We prepared hand sized stickers with a designed space for all three methods: the photo, the narrative explanation and the semantic differential scheme to fill in. Furthermore, we printed two A0 sized posters with a ward floorplan and explanation of the task. Each participant was asked to make two pictures at the ward – one of the place they consider to have highest architectural quality and they like to be and work in, another one of the place, they consider less successful and dislike. Then the pictures, together with comments and scheme could be placed on the floorplan posters, separate to positive and negative spaces, with marked location.

The results in general give an easy overview of specific examples of weak and successful solutions in hospital architecture. Focus areas on *Evaluation focus flower model* are: aesthetics, context, well –being, symbol, experience.

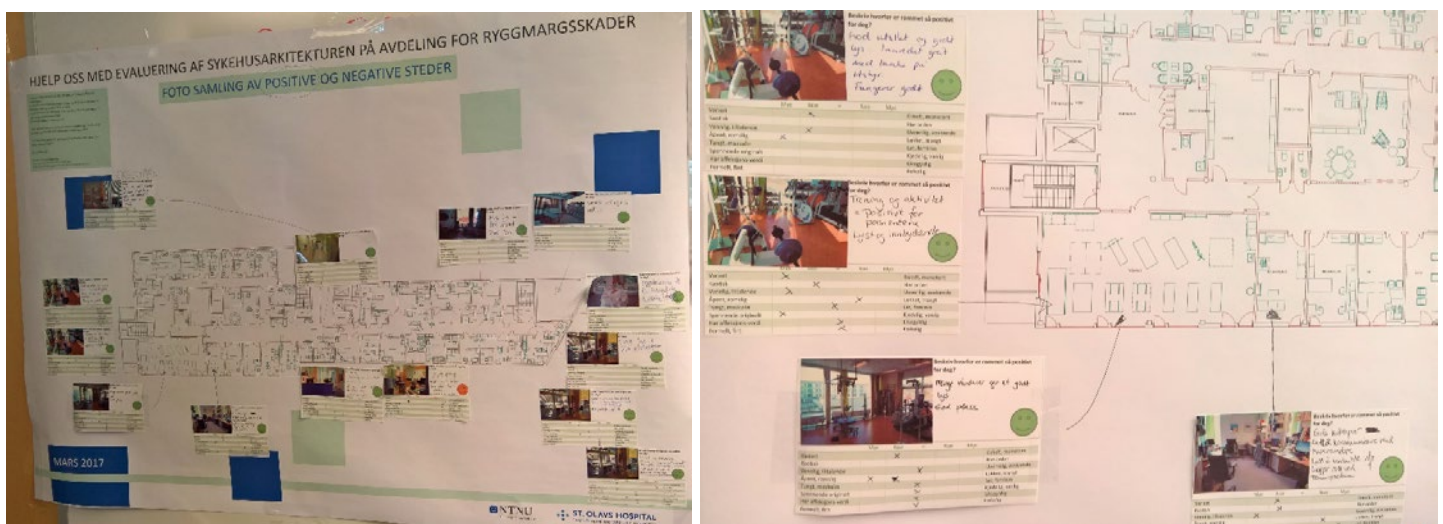


Figure 5 Posters collecting results from evaluation at Department of spinal cord injuries, using three methods: Reflexive photography, narratives, semantic differential scheme

The specific results could include the nursing team station. Exactly as in the staff survey method, the space is evaluated negatively, both picture and text show that the space is not used according to function, see Figure 6.

Semantic differential scheme and combination of methods





## Patient interview and survey

This specific survey and interview guide is developed for patients at single-bed hospital wards (Maben, et al, 2015). This method is scheduled for spring-summer 2017. We will combine interviews with reflexive photography, narratives and semantic differential scheme in order to have a fuller view and comparing the results of more user types using same methods. Expected results are the effect of design on patient experiences and satisfaction, psychology, aesthetics, well-being and health.

## USEtool

USEtool (Blakstad et al, 2009, 2010) is targeted to be used by building owners and Facilities Managers. The tool can be used by the owner organisations themselves for assessing usability of their portfolio of buildings.

The evaluation process has five stages. The first stage is an identification stage (investigation of organisational objectives and identify relevant user groups), and a systematic general usability mapping and a walkthrough with more in-depth qualitative studies of specific usability topics. The last stages include developing recommendations for improvements in existing buildings or briefing for new facilities (Blakstad et al, 2010).

We plan to execute a test of USE tool in the summer 2017, specifically the prepared walk-through with focus on usability. The participants will be a more diverse group, including both the department's medical director, the hospital architect, a nurse, a patient involved in design workshops and hospital architecture researchers. The walk- through shall give valuable information in the usability theme and focus areas: functionality, spatial organisation, effectiveness, efficiency, user satisfaction. We expect a broad overview of the facility, the structured observations and group summary, and possibly additional information about usability from the user questionnaire part.

# Discussion and conclusions

We chose a set of methods for evaluating architectural quality and usability of hospital buildings. From the multiple methods for evaluating buildings, we chose seven methods that appear to cover most focus areas on the *Evaluation focus flower model* and are specifically suitable for hospitals. This paper described the selection process and the preliminary results of the five tested evaluation methods and their results.

The **Key stakeholder interviews** provided a good overview of the ward in relation to different topics from the flower model on a strategic level. Many of the interviewees are pleased and proud of the hospital, shared general information about it, its structure and design development through the years, and some background stories behind the chosen solutions. Nevertheless, there were some disagreements in opinions about specific chosen solutions for the whole hospital or specific departments, as the limited flexibility in the centre model. In general, the remarks from key stakeholders were both at a strategic level and specific experiences at a department level and covered many of the topics from the *Evaluation flower model*, as expected.

**AEDET Evolution** provided an overview of the strengths and weaknesses of the quality of architectural design in the studied ward at Nevro Øst rehabilitation centre. Another category of outcomes are the observations and learning about the AEDET method, its procedures and application of it in a hospital setting.

First, there was a difference in which questions were answered at all. The technical questions were answered by the client organisation and to some extent by researchers presented with data, floorplans and department visit. The use and functionality questions were answered by nurse and architect researchers that were listening to the user stories. The architects chose not to answer themes of Character, Form, Engineering and Space, to stay impartial and not judge in their own case.

Second, AEDET is a tool specifically directed towards achieving excellence in design, a method for evaluating the quality of design in healthcare buildings. Specifically, it indicates the strengths and weaknesses of a design or an existing building. According to the authors, it is designed to be used by public and private sector commissioning clients, developers, design teams, project managers, estates/facilities managers and design. They also add user clients such as patient representatives and members of the general public, that should also be able to use AEDET. However, we found that in our case, even professionals only felt competent to answer some groups of questions. If members of general public were supposed to discuss the scheme, we would recommend guided answering the evaluation form with the prepared facilitator, rather than in a workshop with professional clients and architects. The facilitator role is indeed mentioned in the AEDET descriptions, and the person should ensure that any representatives of the public or patients who may lack experience of technical knowledge are able to express their views and be listened to. We would add that further preparation of those people might be necessary.

Third, we decided to make a site visit at the ward - the unofficial walk-through, which was not part of the original method, but was necessary to answer the questions by the participants, not acquainted with this specific ward at the hospital. The walk-through was unstructured, we did not want to introduce another method into AEDET, in order to separate the outcomes. It resulted in

spending a lot of time along our path through the many rooms, and comments from both the hosting nurse manager and most of the staff met on the way. The comments gave valuable knowledge, but often exceeding the scope of this method. Some of the participants were writing notes on the side of evaluation papers. Some of the comments were not fitting in any of the sections and questions.

We were expecting that some questions might be difficult to answer, but the blank answers were also whole sections by majority of our professional participants. This method appears not to be for everybody as a whole. Either it is for professional assessment by few professional groups, or every participant is only meant to answer some parts, that combined give a full picture of the excellence in design, comparing the high and low scores. In our case the predicted coverage of topics was not fully covered, half of respondents skipped the *technical building performance* questions.

The weighing of each questions (how important the topic is) was unclear for us. We were in doubt whether it shall be predefined by the ordering body (hospital) or part of the participant answer. Finally, one of the researchers decided to use the double weighing in a few of the suggested areas from the AEDET guidance text (questions C: 01,02,04,05 and D04, J06).

The **Staff survey** consists of five sections: 1. on layout, environment and facilities, 2. on 100% single room versus multi-bed accommodation, 3. recent shift on Nevro Øst, 4. job satisfaction, teamwork and safety, 5. background details. In this paper, we present the preliminary highlight results from section 1, We chose the questions about layout and facilities that have high positive or negative scores. The majority agrees on most positive aspects of the ward as: window view on nature for patients, easiness to find way for patients and visitors, and easy bathroom access for patients. The three most common negative answers cover inability to see staff from patient's bed, layout obscuring view on patients for nurses, inadequate space at nursing team station. The survey we tested, is consisting of 173 questions and participants complained about the length of time needed to fill it in. The most appropriate professional group to fill this survey is nurses, others felt some questions are irrelevant. Finally, the answers give a remarkable insight to multiple topics concerning hospital environment, but our concluding remark would be to choose only most relevant questions.

We combined the use of **Reflexive photography, Narratives** and **Semantic differential scheme**. Those methods supply each other and give a quick and balanced overview of multiple qualities of the spaces. They are easy understandable for the staff and give a good overview of specific examples of weak and successful solutions in hospital architecture. This form of combination of the methods require more preparation from the organiser, in form of providing plots of floorplans, the camera and printed scheme stickers.

During the planning of the seven evaluations with different methods, we preliminary decided, which users to involve with which method, in order to avoid repeating procedures. We decided that the **patient interview** appears to be the best method to gain knowledge about the hospital space from the patients. Nevertheless, during the **AEDET evaluation** we noticed, that some of the questions were relevant from a patient view as well. Our reflection now is that it was not the best decision and patients should participate. We would try to get patient answer as well in the next months.

There are a few concerns that shall be remembered for future evaluations. It shall be clear, who the participants and users are and how it influences the results of evaluation, as well as which areas cannot be covered. In the first AEDET test, with diverse user and participant groups, no one was able to fill all of the questions in the questionnaire. AEDET can be used both as a standalone or at workshops. We tested the standalone version, as we were not discussing

our scores with each other. The question can be asked: which version gives more value? There are also expectations towards the next methods - USE tool seems to be better to collect user comments in a walk-through in a structured way. We decided beforehand that patients would best give their answers and opinions in an interview, but in this way we cannot fully test how strong this evaluation method is. In this way the researcher is having a difficult choice, shall all methods be tested fully (maybe at different departments) or shall we test different methods and participants at one department and compare the result?

Concluding, evaluations are not a quick fix. Mix methods approach is needed, that includes quantitative methods for reliability and qualitative methods to understand the reasons and the context. AEDET was covering most of the topics, but needs multidisciplinary competences. All methods require resources - available time, persons and competences. It is suggested for all evaluations in general to always define the scope and the purpose of the evaluation, as it is seldom relevant to evaluate the whole organisation or building or all topics/aspects at the same time.

The preliminary results confirm our hypothesis, that the combination of methods is necessary. All methods appear to cover some areas on the *Evaluation focus flower model* better and leave blank areas. The holes are addressed by picking seven evaluation methods, which together give a good overview of most topics at the *Evaluation focus flower*.

## Further research

Further research can test if the seven chosen methods overlap too much and choose only the most relevant methods, to deliver most value. Additional analyses, including statistical methods, can be made within and between the methods.

Furthermore, research can test the chosen methods on other departments or hospitals. Collected data can contribute to further studies of specific areas by tracking of staff and visualising it on BIM models of the wards, in order to find optimal solutions via simulations. Additionally, there can be made comparisons with online evaluations.

Recent study (Göçer et al, 2015) suggests visualising the data from POE in form of spatial mapping and integrate it to a BIM database. A large BOSSA project about the Australian commercial buildings sector developed a survey system with standardised statistical analysis and stores results in a database (Candido et al, 2015), currently 50 buildings up to 62 000 m<sup>2</sup>. The researchers reduced the number of variables in the survey questionnaire into a smaller set of key dimensions, which gives easier communicated feedback to the stakeholders. We suggest similar techniques in delivering feedback from the multiple methods and lengthy answer sheets.

The next steps could involve development of new national standard methods for evaluations of hospital architecture and collecting databases of their results, which can be shown as BIM models to hospital organisations running existing and regions planning new hospitals.

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# The impact of critical care environment on patient care; staff's view

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## Abstract

Intensive Care Units (ICUs) provide care of seriously ill patients in a highly technological environment. The challenges and substandard environment within ICUs has been recognized since the implementation of such areas in hospitals, and is well investigated. However, a majority of studies have focused on the health outcomes and experiences of patients. In addition, research with regards to care providers has typically focused on specific sections of the care environment, such as light or sound and not the environment as a whole.

The aim of this study was to explore the meanings of ICU patient room as place and space of care from staff's view. Data was collected by means of photo voice; in-depth interview and photographs with 16 ICU nurses. Data was analysed using a deductive content analysis approach.

Results show that ICU nurses are highly affected by their working environment, and particular impact was ascribed to medical technology, work stations, windows, lamps and lights, beds, doors, room dividers and chairs. For work productivity the above were considered useful tools; however, when in a limited space, it was reported that integrity and confidentiality could be challenging to maintain, sound becomes a nuisance and light is lacking. This resulted in decreased work satisfaction, which potentially bears consequences for the quality of care.

The study sample recognized that patients may not receive the highest levels of care due to the inadequate work environment of the ICU staff. The increased well-being of care providers could in turn lead to better care, indicating an investment in a better care environment would be worthwhile.

**Keywords:** Health care environment, ICU staff, qualitative study, photovoice

# Introduction

Critically ill and severely injured patients are treated in intensive care units (ICU). ICUs are one of the most high tech and complex hospital settings to design because of the nature of care and due to patients' condition. In providing care for patients with multiple organ failure of the body's most important functions such as breathing, circulation and consciousness close monitoring, patient visibility, high tech equipment and constantly present staff is vital. These facts put a demand on how these setting can be designed. It can be tough both for patients to be cared and for staff to care in this environment (Olausson, 2014, SIR, 2015) and the care environment is of most relevance of how care is pursued (SFAI, 2015). The front figure for nursing Florence Nightingale (1820-1910) stressed the importance of care environment for the patients' recovery. She varied patients' visual appearance, used colour and natural lighting and reduced unnecessary sound (Rubert et al., 2007). This raises a question; why is care environment still substandard when knowledge of its importance has been known for a century?

There are guidelines (similar around the world) to follow when building and renovating ICUs, which include at least 20 m<sup>2</sup> per freestanding bed, noise reduction, adequate lighting and ergonomic working stations. Space is needed for all medical equipment such as telemetry, ventilator and drug pumps (SIR, 2015, SFAI, 2015). In addition, research has shown that single rooms are preferred in ICUs since they reduce risk for patients to develop delirium, induce integrity and confidentiality (Caruso et al., 2014, Ulrich et al., 2004). Many studies stress the significance of a person centred or a healing environment as it appears to have a say about people's wellbeing. For example; light (Engwall, 2015), sound (Johansson 2014) and design appears to have an impact on patients' care and staffs wellbeing (Walch et al., 2005, Zadeh et al., 2014). The similar findings, i.e. physical environment as a major concern in the daily work were presented by Gurses et al (2009). Seven areas of obstacle in daily work in ICU were identified and physical environment appeared to be one hinder in care provision. These obstacles increase the workload of ICU nurses and by extension negatively affect safety and quality of care. It is also known that nurses perception of work environment and patients' satisfaction is correlated, when nurses are happy with their work environment the patients are more satisfied with their hospitalization (Boev, 2012)..

The challenge is to intertwine the perspective of health care staff, families and patients when designing sustainable ICU. Olausson (2014) highlights that there is a clash between these perspectives; traditionally ICUs have been designed in order to provide a decent working environment and not much to be a place to heal and recover from critical illness.

In order to create knowledge about sustainable health care settings, there is need to involve health care professionals as they daily habit this place and space.

# Problem Statement

The care environment in ICU has proven to be of essential in caring for the critically ill patient and their family. The environment has been linked to several aspects of significance such as the potential risk of developing ICU related delirium due to lack of sleep, including risk for medical errors /adverse event and patient safety. Attention has, also recently been paid to patients' and families' experiences of critical care settings (Olausson et al., 2012, Jongerden et al 2013). However, according to our knowledge there is a lack of research examining the meanings of the ICU patient room as a place and space from staff's perspective. In order to offer a healthy working environment which, we also believe has an impact upon the quality of care, there is a need to find more about the meaning of ICU patient room as place to care for critically ill patients and their families. The objective of this study was to explore the meanings of ICU patient room as place and space of care from staff's view.

# Approach

This study has a qualitative explorative design; data was collected at three ICUs; two university hospitals and one regional hospital in Sweden. The ICUs were built in early 90<sup>s</sup> accommodating 8-23 bed spaces. They were also configured similarly beside one of the ICUs was situated on the ground floor assessing a green area. All three ICUs offer advance interventions and postoperative care. There is always one trained nurse or one enrolled nurse present in the room which means that the patients are not restrained physically. At the head of each bed monitoring equipment are placed and a curtain or a foldable separates the beds. Windows, which have a view of another building, are placed behind the beds in the units at the university hospitals.

Nurses traditionally have not been involved in the design process of new ICUs. Their perspective of the environment is an important source of knowledge since they daily habit this place and space. To highlight the importance we invited 11 trained ICU-nurses and five enrolled nurses to participate. Photovoice was used to collect data, which means that both photos and voices are used (Wang and Burris, 1997). The nurses were interviewed at or nearby their workplace for 30- 90 minutes. Before the interview, they were asked to photograph parts of the environment that affected them and their caring. By photographing and during the interview discussing these issues, main topics related to the physical environment was identified. Data was analysed with deductive content analysis and was chosen since the participants' photos was used as a pattern to form our categories. Below we present some of the essential findings.

According to Swedish law (2003:460) there is no necessity to apply for ethical approval for this kind of study i.e., does not involve any intervention or entail sensitive personal data. However, the ethical guidelines outlined by Helsinki Declaration were followed (World Medical Association, 2013). The nurses were provided both oral and written information and informed consent was obtained prior to the process of data collection. The participants were also informed about their rights to withdrawal from the study anytime without any explanation. The chief physicians at all three ICUs have given their written consent and approved the study.

# Analysis

A deductive content analysis described by Hsieh and Shannon (2005) was used to analyse the data. The main purpose of content analysis is to develop knowledge, and provide new understanding about a specific phenomenon. Deductive analyse means that the categories are determined prior to the process of analysis to discover a pattern in the data. The predetermined categories could be domain reported in the literature or theories (Hsieh & Shannon, 2005). In this study we used photographs taken by the nurses to establish categories. All the interviews were read carefully several times. Then photographs were sorted based on their motives and content and various categories were created. Then, all the interview texts were sorted and related to these categories. The text was critically examined and discussed in the research group in order uncover the meanings of it, with the respect to the data as a whole.

# Findings

Our interest in this study was to explore nurses' experience of the ICU patient room as a place for providing care for the critically ill and their families. Therefore we performed a deductive content analysis of the data, using both photos and the text when interpreting the data. In what follows we present some findings from the actual study.

## Space

The rooms in the ICUs where the study took place were all of moderate size and the modern medical equipment took up space, many nurses described the rooms as under dimensioned considering the equipment. Most of the rooms were experienced as dark and narrow, and sometimes, because of lack of space they abstained from certain care, for example mobilization and hygiene, even though it is a part of the daily routine, and of paramount significance for patients' process of recovery. They also needed to move around the heavy equipment, which was a burden to their bodies or stand in different angles in order to come near and care for the patient.

*"Purely in my body, it becomes strange work positions, I can stretch myself to all sides sometimes upwards downwards ahead ... so it affects my body that it is burdened"* IP15

The nurses became frustrated using all their energy trying to come near the patient instead of caring for the patient. They also expressed that the patient safety was at risk since it was easy to get tangled up in different wires, which could leave the patients without respiration or medication.

*"Why do we have it like this..? What if there was this huge room and I reached the patient very easy and very simple, then I wouldn't have to put a lot of energy into those situations as I have to crawl and so on, it prevents me from doing a good job of course, it takes a lot of energy from what I rather spend time doing."* IP3

Picture 1



View of the ICU room from the working station

All nurses in the study were aware of the importance of visits from next of kin, but having them in the narrow rooms next to the patients made caring difficult. They wished for spacious rooms where everything and everyone had their own place. In that case they would not have to abstain from care or feel that they disturbed the patients and their loved ones. Having two or more patients in the same room makes the room even narrower. The curtain or foldable that separates the patients is not only taking up space but also hinder the nurses from monitoring the patients. They do use them in spite of this to try to make a private space for the patients and protect the patients' integrity.

*"When you have a curtain it feels like your own little compartment in some way... you settle and it becomes your room!"* IP9

## Windows

To have a window in the patient room with daylight and a view affects the staff and in the prolonging their provision of care. They described how they feel more positive when caring in a room with a view as they see the weather and nature. They also described feeling discouraged when working in constant darkness when spending their shift in a room with a small window without a view. Some of the rooms have a brick wall as a view because the building is so close to each other. The staff described they became tired and felt uneasy as they went in to the room at the start of their shift and felt a relief as they finish work and left the room. Some of the nurses interviewed was asked to give suggestions during a reconstruction of their ward some years ago and wished for big windows but felt that their opinions were not listened to as small windows were put in to fit the facade.

*"you might get more inspiration to maybe make a little extra if it's bright outside, or it can be cozy when you notice that it's raining and I think it's associated, it's strange to be secluded from the outside world like we are"*  
IP12

**Picture 2**



**The view from the winow in one of ICUs**

**Picture 3**



**The view from the window in one of ICUs**

The staff experienced that intensive care patients often have nightmares and a hard time separating them from reality. They described how they use the windows and view to help create reality for them. The patients lay in their beds facing the working station and the door to the corridor. Sometimes the nurses, when they have time and space, turn the bed around so the patients can see out and maybe open the window. These efforts make the nurses feel that they are doing a good job; they believe that this helps the patient's recovery process, seeing that the normal world is still there and they have something to fight for.

*"Maybe you can open the window and they can feel the wind in their face like that, you can hear the birds, to get a little, you get a bit of life and not just only intensive care. You see that there is a world outside" IP16*



Picture 4



The placement of medical equipment

## Working station

The staff described that they want to be close to the patient, they feel that they have control when they are inside the room and that they lose important information when they go outside. *"what's fascinating about the intensive care work is getting to be so close to my patient"* IP 9

They want to have their work material, pharmaceuticals and computer close. If something happens it happens fast and they want the accessibility. Having the working station inside the room makes the work easier but can also jeopardize the patient safety as the nurses get disrupted when preparing drugs. It gets very crowded as the computer is close to the pharmaceutical preparation bench and many different health care providers' needs access to the computer. They felt that the fact that all work takes place inside the room just by the patient bed also means difficulty maintaining confidentiality as rounds and reports takes place there.

*"At report, or if you're sitting and talking on the phone... you have one patient just a couple of meters from the other patient and both is looking in our direction"* IP13

**Figure 5**



View from the working station in a two- bed ICU room

To reduce disturbance the nurses suggest that the working station should be separated by a soundproof glass wall but still close to the patient. There, they can see the patient and have control but work undisturbed and talk unhindered and maintain confidentiality.

# Discussion

The findings provide an insight in how ICU patient room as a place and space has an impact on care provision. The configuration of these places cannot be ignored because the substandard of the patient room means a substandard of the care, as it limits the staff in their caring and nursing activities, this is also presented by Gurses et al, (2009) One major issue nurses shed a light on, in this study, was lack of enough space and the openness of the patient room. As shown in our result enough space is essential for the nurses to be able to work safely, come near the patients without getting frustrated, which can affect the care of the patient. Without enough space certain care are obtained from i.e. mobilization which is known to be of importance for their recovery (Hashem et al., 2016). These aspects give rise to ethical concern in several ways; we argue that there is an inherent relationship between how these spaces are designed and ethics. A purposeful design supports and responds to the need and demand of people who inhabit these spaces. This must also be the goal and intention of architecture. The design of the settings studied here reminds of the panopticon that Foucault (1995) discuss. The essence of panopticism besides amplifying the power structure is visibility and observation. The patients in ICU are constantly on display; they are visible and observed. This is of course necessary to ensure survival. However, the goal of intensive care is not only to assure survival but also to promote a successful recovery in terms of regaining meaningfulness in life and thus being able to fulfill the project of life (SIR, 2015). The substandard of ICU patient rooms is an obvious obstacle in achieving this. The patients survive, they receive care and treatment but we know they are traumatized after discharge. Thus one can say the intention of intensive care contradicts the outcome of it. We could see the patients' integrity could be breached; they were exposed when care was provided in substandard settings. The fact that the working station is close to the patient bed gives the nurses a sense of control but it is also challenging maintaining confidentiality. Having the working station inside the patient room furthermore cause disruption when preparing drugs, documenting and having rounds. Disruption during drug preparation is the most common cause to medical errors (Hayes et al., 2015). Our results, among other studies, suggest that a working station behind a soundproof glass wall could reduce disruptions, increase integrity and confidentiality (Blomkvist et al., 2005, Halpern, 2014). Of course one can reflect over whether this is only related to poor design? We argue that poor design put a greater demand on staff protect integrity and promote patients and families wellbeing and this is not always the first priority when life is at stake. Here a purposeful design could be beneficial and necessary.

Reminding us of what Nightingale stated years ago we could say that the place of care, per se, cannot be separated from nursing care. Nor it can be separated from the nurses exercising care. The actual study shows the wellbeing of staff is at stake in such environment and subsequently the quality of care. Windows and daylight are of importance for the nurses to feel positive, when working in a dark room they get tired and discouraged. Other studies have shown connection between windows and the wellbeing of nurses but also patients (Zadeh et al., 2014, Walch et al., 2005). Not seeing the daylight, working in narrow spaces coupled with stress related to the work, increases the risk of burnout. This also recognized by a literature review by Epp (2012).

Finally, the design of environment is a matter of patient safety. Nurses need a healthy working environment in order to care, safeguard patient safety and patient satisfaction. We strongly argue that the hospital leadership has an overall responsibility in updating and assuring a safe and appealing environment in ICU.

# Design Goals

Suggestions from participants revealed during interviews.

- All ICU rooms should be single rooms
- Better access to the patient i.e. using pendulum from the ceiling
- Space around the patient bed and space for family's visit
- Reduce the noise level, i. e. using sound absorbents on the walls but also for cabins and drawer.
- Ensuring privacy
- Visibility from working station without being in the room i.e. a transparent wall/ glass wall.
- Providing large windows allowing daylight and view
- Adjustable lightning system

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## Abstract

*Modern design thinking welcomes design strategies that actively involve and cooperate with the user. Designing has grown into creating for people, with people. In the Nordic Region Co-design and Participatory Design are well known methods for bridging the gap between designer and user. Based on the on-going PhD research project "Generating Inclusive Built Environments through User Driven Dialogue in the Architectural Design Process", along with qualitative research conducted at the Danish Building Research Institute, this paper discusses the role of the disabled user in the design process of inclusive architecture.*

*The Disabled People's Organisations Denmark (DPOD) is one of the core actors in user participation related to accessibility and Universal design (UD). However, there seems to be a confusion regarding the role and responsibilities of these users. As users of accessible solutions and UD, the DPOD representatives are repeatedly mistaken for experts on accessible design and the current Danish Building Regulations. Consequently, the DPOD representatives are seen as guarantors of the correct and legitimate design solution.*

*This confusion combined with the user's partial understanding of complex architectural processes and the architect's limited knowledge of "life with a disability" leads to misinterpretations in the collaborative relationships. These misunderstandings might lead to hindrances in the process as well as architectural solutions that do not meet expectations.*

*The aim of this article is to shed light on these misinterpretations and discuss the role as well as reflect upon the knowledge potential of the user, in generating built inclusive environments. Through research data and theory the article analyses the current situation and discusses the implication of revising the user role. Hence the aim of this article is to contribute to the process of redefining the role of the user, with regard to UD as process and design solution.*

**Keywords:** user involvement, user organisations, design process, universal design, architecture



# Introduction

To some extent, modern design thinking has developed into creating for people, with people. The term 'Design Participation' was introduced in 1971, at a three day Design Research Society Conference, in Manchester [Cross, (1972)]. In this conference, Reg Talbot and Nigel Cross, organisers of the Design Research Society had included participatory management and dynamic design games. Since then, this approach has spread and influenced industrial design and, in hybrid forms, the architectural field, in many countries. Design thinking and the role of creating in the architectural process have been taking on new forms and involving new participants.

In the Nordic Region, Participatory Design, Co-design and User-Centered Design has become well known frameworks of processes to bridge the gap between the designer and the user and also a political means to support inclusive strategies in order to involve the community. User-driven development is not really a set of methodologies, but a philosophy or paradigm that a collaborative team can follow. Hence this development has articulated new roles for designers and architects, in order to reconsider and transform design processes and create new platforms for social inclusion in design practice.

The participatory design approach has also addressed a need for a clarification and a precision of the framework of the user's role, scope and answerability in the collaborative relationships.

In a Danish context, this development of modern design thinking also relates to processes of accessible design solutions and inclusive architecture. The Disabled People's Organisations Denmark (DPOD) has become one of the core actors in participatory processes of accessible design solutions and inclusive built environments and their active participation is reflected at global, national and local levels [<http://www.handicap.dk/politik/>].

The reason for these organisations' active participation in processes of accessibility and inclusive architecture stems from an absence of interest or engagement in the professional building landscape of stakeholders and practicing architects. The lack of attention to this subject could indicate that accessibility and universal design is yet to be defined and implemented as architectural design values in architectural strategies and methods.

The Disabled People's Organisations Denmark is a national umbrella organisation with 33 member organisations embracing more than 330.000 members. DPOD defines their commitment to engage in efforts that serve to encourage and protect the rights of persons with disabilities.



Figure1. House of Disabled People's Organisations Denmark / Cubo and Force4

## Body-based discrimination in built environments

With the overall ambition to eliminate body-based discrimination in built environments and thereby improve independence and everyday life for persons with impairments, the Disabled People's Organisations Denmark takes a political starting point in the United Nations Convention on the Rights of Persons with Disabilities. The UN Convention not only makes clear that states should not discriminate against persons with disabilities, the Convention also explains the many steps that states must take to establish an inclusive environment in order to let persons with disabilities enjoy equality in society.

The strengthening of the United Nations Convention on the Rights of Persons with Disabilities includes the approach and inspirations of Universal design.

When we use the term universal design (UD) in this article, it refers to a broad spectrum of ideas meant to produce buildings, products and environments that are inherently directly accessible to children, older people, people without disabilities, and people with disabilities. Universal design is referred to as a design strategy for architecture and landscaping as well as strategies to meet external political and social aspirations in the future.

Universal design values embrace the importance of social inclusion in line with the Rights of Persons with Disabilities and point out the importance of accessibility as an interaction between society and individuals. The Rights of Persons with Disabilities emphasise equality, inclusion and the understanding that difference in ability is a natural and foreseeable human condition or experience. From that perspective, physical barriers and limitations are environmental challenges.

This view is often referred to as a social model of disability. The social model is a critical reaction to the earlier dominant biological or medical model which in itself is a functional analysis of the body as a machine to be fixed in order to conform to normative values [Lid, (2010)].

The social model of disability identifies barriers, negative attitudes and exclusion by environments and society. From this perspective, the physical environment and society are the primary contributory factors in disabling people. Although physical, intellectual, sensory or psychological variety may cause individual functional limitations or impairment; these do not have to initiate disability, unless societies fail to include people regardless of their in-

dividual differences. The social model of disability can be traced to the 1960s, and the specific term emerged in the United Kingdom in the 1980s.

Earlier views were based on the perception that the limitation resided in the individual, in the human body. This view confined disability to a permanent condition arising from disease or injury. A person was considered disabled due to individual and health-related causes. This is called a biological or medical model of disability.

These two models, the social model of disability and the medical model of disability are noteworthy components in this article as we touch on the different interpretations of disability together with accessibility and universal design [Lid, (2010)] [Charlton.(2000)] [ Garland Thomson ,(1996)].

Along with moving the perspective of limitations from the individual to the surroundings, universal design responds to the awareness that accessible design solutions and inclusive built environments should not only eliminate barriers for some, but also enhance experiences for everyone.

From this viewpoint, the Disabled People's Organisations Denmark are building the commitment and engagement to inspire and support inclusive built environments, offering guidance and user perception in design and architectural processes. User representatives of the organisation share their experience of accessibility and inclusive design in an effort to contribute to the design process with a "one to one insight" of accessible solutions.

However the dialogue and the cooperation between this particular user group and the professional stakeholders and architects have not yet been studied.

Despite examples of collaboration between the architectural field and the DPOD user group, it is a challenge in Denmark to build architecture and shape physical environments so that it favors the motivation that universal design meets the expectations of the user group. Architecture infrequently shows an integrated and holistic approach when it comes to UD and accessible design solutions. [Frandsen, et al, (2012)] [Ryhl & Frandsen, (2016)]

In this article, the term architecture covers the planned and built environment and outdoor spaces. We use the term pragmatically and objectively to cover the built environment constructed to facilitate and support human life and interaction. Lack of accessibility in architecture hinders people with impairment from exercising their right to be a part of and interact with society, such as the right to an education, take part in politics, meet friends and family and enjoy nature and cultural life.

This overall challenge stems from various obstacles of unclear interpretations of accessibility and UD, fragmented knowledge of accessibility and UD and undefined collaborative relations with the user group.

A long-standing predominant focus on physical accessibility and its codification has led to critiques in the architectural field upon the legislative interpretation of accessibility and UD, represented by rules and standards. This critical position develops from the view that the interpretation of accessibility and UD in the Danish Building Regulation is a limitation of the creative design processes and innovative thinking. [Ryhl, C (2009)] [Frandsen, et al, (2012)] [Kirkeby, et al, (2014)]

Nevertheless, the potential of addressing the objectives behind building legislation and regulations as an encouraging supplement to the regulations' measurements and standards is not met by the schools of architecture. Accessibility and universal design is not yet to be found in the architectural education or training in Denmark.

The Danish Building Research Institute (SBI) has been conducting research on UD and encouraged the development of inclusive built environments and accessible design solutions for more than a decade. The research is not only covering the level of building's functionality, but also includes human aspects of spatial experiences, sensory features and social responsibility.

However the exchange of knowledge between researchers and the practicing architectural field still appears to be a challenge. With the intention of furthering the comprehensive understanding of UD, the challenge is to develop a means to describe and communicate spatial quality and social values of accessibility and UD in architecture [Kirkeby (2005)]

The social perception of accessibility and Universal design is not necessarily a part of the awareness of the architect. A predominant focus on physical accessibility and the Building Regulations' operational measurements has led to a specific approach which often includes accessible design solutions in the final phases of projects, often as "add-on solutions".

Add-on solutions in this article cover prefabricated accessible solutions meant to specifically support persons with impairment in contrast to solutions designed and incorporated in the architectural scheme, supporting human diversity and differences in the body's physical ability.

These add-on solutions do not necessarily correspond with other architectural elements in the project neither are they responding to the manifold interactions between the body's physical diversities and inclusive environments. They are specific design solutions for specific people.

Absence of universal design strategies in the architectural practice indicates that universal design is yet to be defined and implemented as social values and spatial quality in the architectural education and working methods.

Among other aspects, the lack of implementation of UD in architecture may be related to limited knowledge and experience which strengthen and inspire the design process. Or it may be related to useful and already existing knowledge not addressed in architectural practice. Importantly, this questions functionality and efficiency of collaborative relationships with the user. Is user participation and dialogue always an enrichment of the design process? How do the DPOD user representatives address need-based knowledge to the architectural field so that it can inspire and meet both functional expectations and architectural qualities?

Other aspects may be the basis of the challenge - the task of anchoring universal design as a natural part of the architectural thinking.

In this article, we discuss and reflect on competences and the knowledge potential of users, for generating inclusive built environments. We will suggest our knowledge potential, which could inspire innovative design processes.

We argue that knowledge plays an important role in the creation of built environments and that knowledge is not just statically stored in creative processes. The transfer of knowledge, from the place it is created or stored to the place it needs to be applied is therefore essential. Hence, sharing of experiences and knowledge flow are important means to meet innovative design strategies that actively involves and cooperate with the user.

The term knowledge flow is seen as a passing of shareable content between actors and contains three important components: direction (sender and receiver), carrier (medium) and content. It is the process that transforms knowledge from constructed knowledge in the source context to translated knowledge embedded in practice in the target context. A good knowledge

flow enables participants to cooperate effectively and share useful experience (Zhuge, 2006).

Since our physical environment is rarely designed and built with attention to UD, and as solutions with a focus on accessibility and equality are not incorporated in the architectural practice, it calls for a broader consideration of both the collaborative relationships with the users and the knowledge potential of the users. Broader studies of the existing, or not existing dialogue and knowledge flow between the architectural field and user representation of people with impairments.



Figure2. Hazelwood School in Glasgow, United Kingdom/ Alan Dunlop Architect Limited

### The role of the user in collaborative relationships

In order to be brought closer to the understanding of the role of users in this particular collaborative relationship, the research study *“Generating Inclusive Built Environments through User Driven Dialogue in the Architectural Design Process”* explores and discusses the nature of the current relationship and then reflects on the potential of redefining the role of the user in the relation.

With the motivation to shed light on the user-driven discourse and interaction with the architectural field, the research study explores the landscape of accessibility and universal design with special attention to this collaborative relationship.

The framework consists of objectives to identify and reflect on the role of this particular user group and discusses their experience and competence to be being dialogue partners in design processes. It is the ambition to provide a critical reflection on the current situation and possibly suggest opportunities of development and potential for strengthening the user representatives as dialogue partners.

In the ambition of change and enhancement of user representation in the Disabled People's Organisations Denmark, the study draws on references from action research methodologies and involves the organisation, whilst simultaneously conducting research. The research is to some extent based on participating observation in the DPOD organization and a close dialogue with its core actors of disability policy. Through observations of the actual DPOD engagements for eliminating discrimination in built environments, the close relation allows practice-related knowledge to be a part of the empirical source of knowledge. [Nielsen & Nielsen (2016)]

With ambitions to identify and possibly enhance the qualifications and competences of the DPOD user representatives as dialogue partners and user participants, the study views political DPOD strategies and observes characteristics of work culture and interaction with the building industry. The observations build on participation in meetings and daily responsibilities as an observer, for the most part as "a fly on the wall".

In corporation with the DPOD, It is the ambition to formulate how can the DPOD user representatives address need-based knowledge to the architectural field so that it can be translated into architectural form and function. The process that transforms knowledge from the source context to translated knowledge embedded in practice. How can DPOD user representation support innovative design processes?

Empirical knowledge gained from existing research, observations and qualitative interviews with both DPOD representatives and professional stakeholders from the building industry is generating a perspective covering the experiences of the two parts in the collaborative relationship. The knowledge is gained from semi-structured interviews with twelve DPOD representatives and with representatives of six core organisations from the Danish building industry. The twelve chosen DPOD representatives cover a group of disabilities which are all interrelated with requirements of accessible design solutions, such as wheelchair users, visually impaired, hearing impaired, speech-language impaired and intellectually impaired.

Groups of disabilities with no direct relation to requirements of accessible design solutions are not a part of the interviews, such as diabetes, attention-deficit/hyperactivity disorder, epilepsy, heart conditions and emotional disturbance. However, informal and un-structured interviews and conversation with these groups has clarified if the group has a focus, or a requirement for accessible design solutions.

The conducted qualitative research studies indicate discoveries which might answer the questions of how DPOD user representation can support developments of inclusive environments. Notably, we must acknowledge that these studies of the user's role in this particular collaborative relationship are still in their first phases and additional interviews are conducted as this article is written.

The interviews draw on an interview guide, a list of questions and themes that need to be covered during the conversation. The semi-structured guide provides a clear set of directions for the interviewer to provide consistent, comparable qualitative data. However the inclusion of open ended questions and preparation of the interviewer to follow relevant themes that may stray from the interview guide does, still offer an opening for identifying new ways

of seeing and understanding the theme. Furthermore the open ended questions give respondents the opportunity to explain if they do not understand the question or do not have an opinion on the subject. The semi-structured interviews of this project, are preceded by observation, informal and unstructured interviewing, in order to grow a profound understanding of the subject of interest required for developing applicable and meaningful semi-structured questions.

Preliminary findings points to an overall confusion regarding the role and responsibility of the user representatives in the architectural field and in the user group itself.

As users of accessible design solutions, the DPOD user representatives are expected to possess certain knowledge of accessibility and universal design. However, as users of accessible solutions and UD, the user representatives are very often mistaken for experts in accessible design solutions and building regulations. As a result the DPOD users are seen as guarantors for the correct and legitimate design solution by architects and building contractors.

Qualitative interviews with representatives of core organisations from the building industry and practicing architects indicate the understanding that involving the DPOD representatives is a way of securing and approving accessible design solutions in architecture. This view can lead to misinterpretations of commitment and responsibility in the collaborative design process and give the impression that the competences of user representatives are more comprehensive than they really are.

Interviews with representatives of DPOD member organisations show a general perception of being “taken as a hostage” in the design process or being misunderstood as a professional accessibility consultant or specialist. The experiences of misinterpretations are confirmed and emphasised by the participating observations in the DPOD organisation. The narrative of “being taken as a hostage in the design process” is per se a well-known phenomenon in the user group and in the organisation.

The users representatives experience the functionality of accessible design solutions on their own body and in so doing they can contribute with experienced descriptions of design and functionality. However, can we expect users to support architectural knowledge and furthermore be experts of accessible designs?

User representation in DPOD consists of unpaid assistants offering an individual user perspective in design and construction processes. The DPOD representatives should not be seen as professional consultants or as guarantors for the correct and legitimate design solution. This responsibility lies with the professional building owner/contractor and the professional consultants. User representation supports the professional design process, facilitating need-based knowledge and “one-to-one insight” of accessible solutions.

This facilitation can entirely be seen as a non-professional supplement disengaged of authorized or legitimate responsibilities.

This understanding is confirmed and emphasised in some of the research interviews with DPOD representatives, others find their role and competences more unclear.

It is essential to communicate the understanding of the user role, competences and responsibilities to the architectural field and the building industry. Undefined roles and unclear expectations blur the collaborative process and are reflected in the final product.

The undefined role of the user representatives is also to be found in the DPOD organisation itself. It shows as enlarged expectations to the DPOD

user representatives and their competences. As a national organisation, DPOD, is expected to represent all member organisations of the umbrella organisation and support their overall ambitions – and so are the user representatives. However, interviews with representatives from DPOD member organisations show the challenge of being spokesman for the large group of very different organisations to be practically impossible.

Interviewees point out that user representatives of member organisations who live their lives with impairment facilitate need-based knowledge on the basis of experience of the built environment having a particular impairment. Hence it is a comprehensive task to facilitate and to guide on behalf of a large group of diverse people with a variation of impairments. To be a member of one particular user group and mediate very specific need-based knowledge and at the same time represent all of DPOD's member needs is complicated. One design outcome can be the ideal solution for one group of users and at the same time not a functional solution for the other group of users.

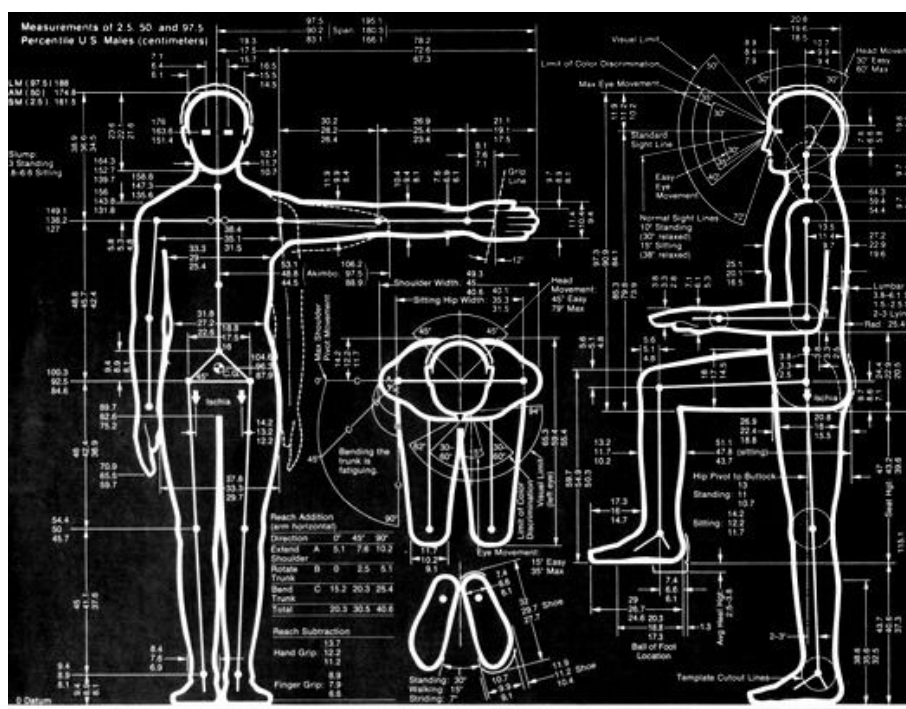


Figure 3. Anthropometric dimensions of the human body



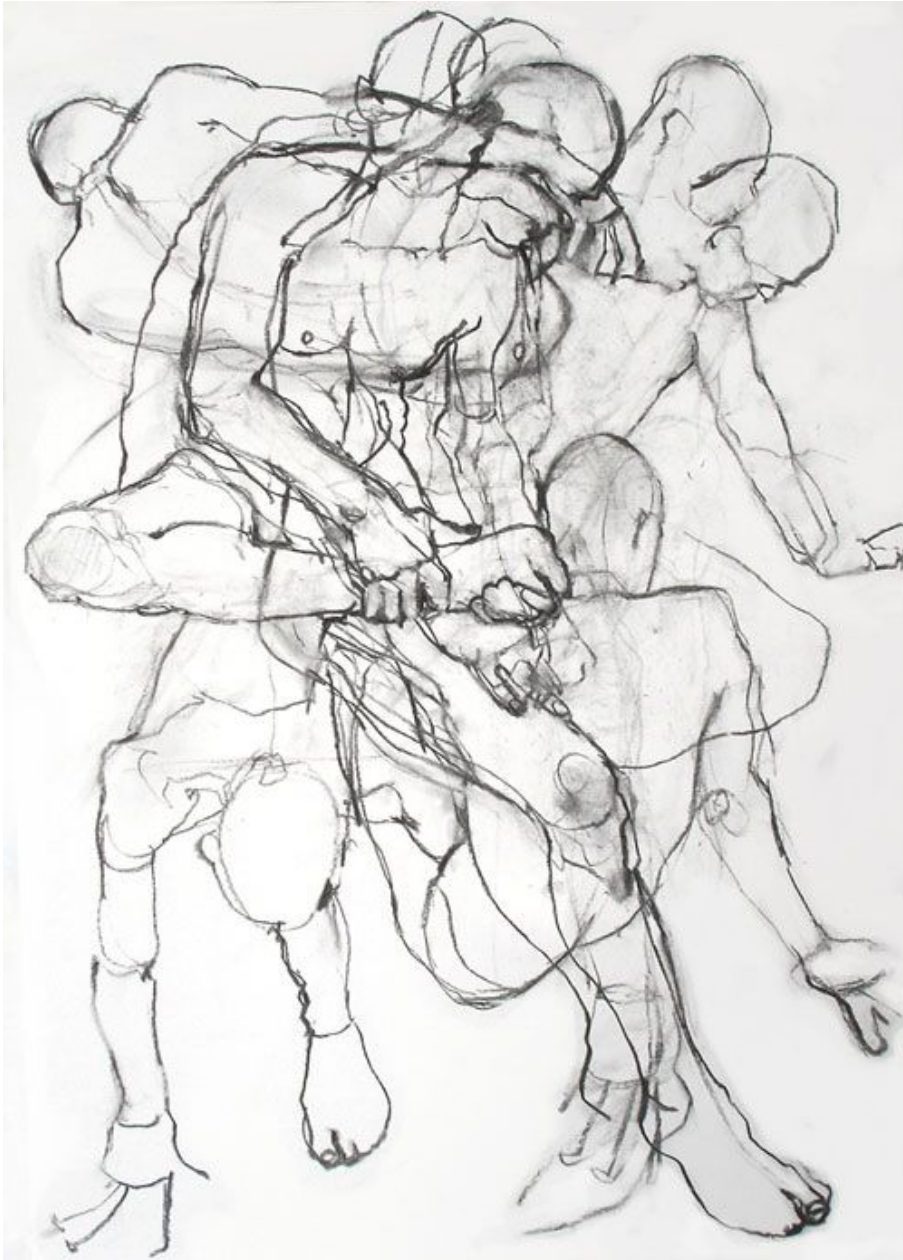


Figure 4. Movement of the human body

## Knowledge potentials of the user, in the shaping inclusive environments

This overall confusion regarding the role and competences of the user representatives and the user's limited understanding of complex architectural design and building processes indicate obstacles in the collaborative process. At the same time, this indication suggests potential opportunities to explore new platforms for user participation in design practice.

The user's partial understanding of complex architectural design and building processes appears to be a hindrance for the dialogue between users and the building industry, which causes misunderstandings in the collaborative relationships. Interviews with core organisations from the building industry and practicing architects point out lack of knowledge of architectural methods and processes in the user group, as an essential challenge in the relation.

It is a challenge for the architectural field to simplify and exemplify the architectural complexity and meet the user representatives in a mutual position.

This can cause an unbalanced dialogue between the architect who possesses the insight and knowledge and the user who is a layperson trying to follow the architect.

As a result, the DPOD user representatives generally appear to find support and direction in legislation and the current Danish Building Regulations. Interviews with the user representatives and observations in the organisation uncover the legislation and the current Danish Building Regulations as important argument tools for the user representatives. It is seen as a means to “speak the same language” as the architect and thereby having a more balanced dialogue.

However, building legislation is not the responsibility of the user representatives to facilitate, but the responsibility of the building contractors and their consultant to examine in order to comply with the Danish Building Regulations

Mirroring this, the user’s partial understanding of complex architectural processes limited knowledge of “life with a disability” in the architectural field, point out reverse difficulties in the relation. Along with a possible resource to balance the dialogue this draws attention to knowledge potentials for the user representatives to meet. This sort of knowledge, “life with a disability” is useful knowledge for the practicing architects in the process of understanding the user and translating requirements into architectural form and function.

This indicates the importance that users facilitate knowledge which builds on the body’s life experiences together with the understanding that body’s physical diversity and difference in ability is a natural part of our lives. Difference is a characteristic of human diversity. [Lid, (2010) Lid, (2012)]

Qualitative interviews with professional stakeholders in the building industry to some degree show a more uniform understanding of human diversity and accessibility. Accessibility is, in many cases, understood as specific design solutions for specific people. In this view, impairment is understood as a deviation from the norm, from what is understood as ordinary or normal.

This view does not correspond with the participatory approach and inspiration of DPOD. As the organisation’s understanding of user participation is built on United Nations Convention on the Rights of Persons with Disabilities, they place an emphasis on the understanding that difference in ability is a natural human condition.

This calls attention to the user representatives and the importance of carefully communicating this motivation to the collaborative dialogue partners.

The research also points out a great potential of the user representatives in mediating the social aspects of accessibility and meeting the architectural values of social responsibilities and holistic strategies. These values are a natural part of the architectural education and architectural practice and they are inspired by most architectural approaches.



Figure 5. Advancing the dialogue

## Perspectives: Advancing the dialogue

Understanding of daily life with impairments is essential for designers and architects, in order to recognize, how accessible design and user friendly solutions supports and inspires independence and empowerment. When living with impairment, independence and social interaction is dependent on inclusive design thinking and functional architecture. Poorly functional design solutions and non-inclusive architecture hinder independence and social life for persons with a disability.

In facilitating the social implications of accessibility, there is the potential of addressing the objectives behind building legislation and regulations as an encouraging supplement to the regulations' operational measurements and standards. The DPOD user represents the experience and knowledge of the user needs represented in the Danish Building Regulations. This is valuable knowledge for the practicing architect to possess in the process of translating need-based knowledge into form and function and understanding the expectations of the users.

We argue that it is valid for the architect to know how inclusive environments and good accessible design solutions can embrace independence and empowerment. Knowledge based on physical experiences in architecture and the social motivations behind accessibility and universal design indicate a knowledge potential that the user representatives could meet. It can also be seen as a contribution to the process of redefining and emphasising the role and responsibilities of the DPOD user representation.

An understanding of, and empathy with, the user group is essential for creating new platforms for inclusion in design practice and for generating inclusive environments in a collaborative relationship. We recognise that archi-

itects gain knowledge through education, practice and personal experience. Nevertheless, in specific processes of designing, such as those involving participants who are different from themselves architects cannot rely on past experience.

From this, the notion of advanced dialogue and an optimised flow of knowledge is a forward-thinking strategy towards developing and maintaining the understanding of the user throughout the design process. Even though designers and architects have come a long way towards involving users while designing, it is still considered a challenge to develop understanding and meet the expectations of users when they are not present. Without an ongoing dialogue and knowledge of how a space may be perceived, interpreted and experienced by the user group (in this case persons with a disability) collaborative relationships are of no use/ineffectual.

This draws attention to collaborative processes that involve the user in the development cycle from the starting point and that make room for recurrent scenarios of evaluation and further development.

In order to facilitate innovative collaborations with the architectural field, it is necessary to revise the role of the DPOD user representative as well as a more delimited room for manoeuvre might be valuable. Furthermore a careful differentiation between the knowledge and experience that the two parties bring to the collaborative relationship could lead to future innovative design processes.

Knowledge of the user group, based on physical experiences of perceiving architecture, exhibits great potential of supporting practicing architects in the design process. Conversely, insight in architectural processes and building phase's exhibits great potential for supporting the user in mediating need-based knowledge in the collaborative process.

With the motivations of furthering the comprehensive understanding of accessibility and UD as architectural values, our research is mediating the social aspects and responsibilities of accessibility and in order to bring useful knowledge to advanced architectural dialogues and strategies. Our continuous studies of the collaboration, and pointing out of potential, aim to support architects and user representatives in shaping built environments that are accessible and inclusive.

From this, the notion of involving the user in the development cycle from the starting point, advancing the dialogue and optimising the flow of knowledge is forward-thinking strategy towards maintaining and understanding of the user and developing inclusive built environments that not only eliminate barriers for some, but also enhance experiences for everyone. And even more so, this notion might enhance the understanding of the real field of expertise of the user.

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- <http://www.handicap.dk/politik/>

# The Architectural Question of Vandhalla – to Compensate or to Stimulate?

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## Abstract

*In a Danish context, people with mobility impairments suffer from poor health compared with the rest of the population. They weigh more, exercise less and participate less in the cultural and social activities of everyday life. However, persons with disabilities, who are active in sports, are significantly more often employed, engaged in civic and voluntary activities and have a higher educational level compared with other persons with disabilities. In other words, participation in physical activities increases participation in other fields of society and functions as a lever for individual health and well-being.*

*Egmont, a Danish folk high school has already acknowledged the effect of sport in its work on rehabilitation, habilitation, health and well-being. Egmont is open to everyone but a majority of the students are persons with physical disabilities. In 2013 the new sport centre Vandhalla, which offers numerous new activities was opened. Using Vandhalla as a case, this article discusses how universal design in architecture can support the process of habilitation. Traditionally, accessible design intends to compensate for disabilities, but at Vandhalla the architecture stimulates rather than compensates. Hence the universal design of architecture inspires and supports activities as well as the student's abilities to be self-reliant. Furthermore it increases the sense of joy among the students which can be documented in ever-widening circles in their perceived quality of life.*

*Empirically, this paper is primarily based on a post-occupancy evaluation of Vandhalla. Interviews and walk-throughs were conducted with the winning team, the client, the teachers and the students. Data from other research projects conducted by the authors are included as examples.*

*The concept of 'A Challenging Space' is introduced and used as an analytical framework.*

*Keywords: universal design, rehabilitation, habilitation, health and well-being, participation*

# Background

With regard to disability and architecture, the emphasis has for many years been placed on *accessibility* as a means to compensate for lost ability, and often practiced as a special design solution specifically accommodating disabled users and hence enhancing stigma and focusing on what is missing rather than on what is present. With regard to disability and physical therapy and health, the focus has been on re-habilitation as opposed to habilitation, resulting to some degree in the same sort of stigma, and enhancing a physical ideal which might be irrelevant to many users.

The project, Vandhalla sports and swimming facility, presented in this article had a basis background in several different aspects of the interaction between architecture, universal design, habilitation and disability, all brought together in synergy in a stimulating architectural space which may enhance self-reliant abilities for the users of the space. The article questions the rehabilitation/accessibility approach as a means to enhance architectural quality or stimulating experiences of space for persons living with a disability. Instead we point to the potential of architecture and universal design to stimulate and challenge the disabled users to expand their individual and personal abilities and hence define new ways of designing and defining how to accommodate disabled users in architecture.

## Sport activities and quality of life

Physical activities play an important role for the health and well-being of all people, including people with disabilities. Nevertheless, research shows that people with disabilities less often practice organised sport than able-bodied people. Having a disability, thus negatively affects the likelihood of practising sport (Damgaard et al. 2013). Several studies have shown the effect of physical activity amongst people with a disability. The general health condition of people with disabilities is poorer compared with the rest of the population concerning smoking, eating habits and sedentary physical activity and excess weight as well as alcohol use (Johnsen et al. 2014).

A Swedish study points out that the well-being of people with disabilities, who are active in sport or exercise regularly, is higher than that of those who do not exercise. Furthermore, a higher percentage of people with disabilities who are physically active in sport are also working or studying compared with physically inactive people with disabilities. Similarly the perceived quality of life is higher among people with disabilities who are active in sport (Norlin, 2008).

Another aspect of life, health and well-being is the social aspect. In the case of institutionalised participation or activities like being together with family, club activities and voluntary work, a disability is not regarded as a barrier by the respondents with disabilities. But the disability is rather a barrier in connection with everyday activities anchored in social activities like drinking coffee at a café, watching a movie in the cinema or other ways of spending time with friends. Because these activities depends on having a sense of belonging to a group of friends and knowing how to cope with the social strategies that these social activities requires (Damgaard et al., 2013)

A Danish quantitative study showed a significant correlation between being physically active in sport on a regular basis and being active in other areas of the society; the civic activities of employment, educational status, leisure time schooling, voluntary work and a participation in disability organisations (Kissow et al., 2012). Kissow conducted a qualitative study in order to study how people with disabilities being active in sport participate across a variety of contexts. Her study shows that experience from one context is carried into other contexts. Hence, participation in one setting promotes participation in another context. In addition, persons with disabilities experience that they develop abilities that they can use in other contexts. Moreover, it is their impression that their participation and their active part in sport open doors for participation in other situations because other people show interest in them, become less uneasy about their presence and instead consider them as a resource. In comparison with other social communities in society, sport activities in the Danish context are relatively easy to participate in due to the organisation and institutionalisation of sport. Therefore physical activities function as a driver for social participation in other settings because of its role as a 'positive spiral of participation' (Kissow, 2013).

## Accessibility

In general, the concept of accessibility in the built environment is regarded as a means to accommodate for people with disabilities, in particular wheelchair users and to some degree visually impaired users. Most practitioners interpret accessibility as being equivalent to the minimum requirements in building regulations and as such the concept of accessibility appears to be a fairly effective legislative tool to ensure physical access to the built environment. However, it is also acknowledged that building requirements focus only on some user needs; hence many user needs and their complex interactions are not included in many building projects as they are not included in the legislative framework (Ryhl, 2009). Furthermore this narrow, legislative and primarily wheelchair-focused approach to accessibility reflects an understanding of accessible designs being special design solutions for disabled user, which appears only to further stigmatise people with disabilities (Frandsen et al, 2012). The design concept of universal design offers a new approach to understanding the users, their diversity and the complexity of users' needs by regarding all users as potential users of universal design throughout their lifetime. Furthermore, as the concept is not interpreted as specific pre-defined design solutions, it holds the potential of being regarded as a more dynamic approach as well as solution. In this line of understanding it is also relevant to talk about the current interpretation of universal design in the Danish context as 1<sup>st</sup> generation (Grangaard and Ryhl, 2016a). Accessibility in the Danish context is most often regarded as a specific, non-dynamic and very functional approach to ensure that the design compensates for the lack of ability and hence compensates for the disability (Ryhl, 2009, 2016). Yet it seems there is a need for a different approach which through design might open up for new and innovative solutions, more dynamic and reciprocating design that offers more than just practical and compensating solutions, but also stimulation, experiences and the possibility to develop individual abilities of the users through challenge. Universal design might hold the potential to be this tool.



## Egmont and Vandhalla

Egmont is a historical institution in the Danish folk high school<sup>1</sup> tradition and system. It was established in 1956 by Olaf Lauth and is the first of its kind in Denmark as it was targeted specifically at disabled students. And in particular students with mobility impairment and wheelchair users. Besides defining disabled users and their personal assistants as the target group, Egmont is also characterised by its vision of empowering students to achieve personal growth and development. It is not only the intention to offer a boarding school experience among peers, but even more so to support all students in their individual growth and development, so that they discover new and strengthened abilities. Through their own empowerment they leave the school with a stronger sense of being part of society, being able to navigate in public spaces. Hence, Egmont aims at more than compensation and functionality and strives to define undiscovered territories, preferably through stimulation, collaboration with their personal assistant and by challenging the individual student all the way<sup>2</sup>. It is the impression of the head of school Ole Lauth that the general institutionalised system focuses more on rehabilitation than habilitation, although the UN Convention on the Rights of Persons with Disabilities embraces both. At Egmont, their vision emphasises the relevance of focusing on habilitation, because more than half of the students have had their disability all their life (Grangaard and Ryhl, 2016b).

The initial buildings at Egmont were not accessible to wheelchairs, but accommodations were made along the way. In 1961, the original buildings were replaced with new construction. Since then, Egmont has been accessible. Today 180 students are accepted every year. Numerous expansion projects have been realised and in 2013 the 50-year-old dream of building a sports and swimming facility for the students was fulfilled<sup>3</sup>.

Vandhalla sports and swimming facility was designed by a team consisting of the two architect firms Cubo and Force4, which won the design competition. Both firms had very little experience and knowledge of accessibility and universal design as they entered the design competition. During the design process of Vandhalla, they also won the design competition for a new headquarters for the Danish Disability Organization, which meant that knowledge and references were to a certain extent mutually exchanged between the two projects.

Vandhalla is the name of the sports and swimming facility inaugurated in 2013 and since then used every day by the students and employees at Egmont, as well as by the local villagers. One of the specific mile stones of Vandhalla is the construction of a fully accessible water slide, to be used by all students, regardless of abilities. It is the first of its kind in Denmark (Grangaard and Ryhl, 2016b). But Vandhalla also presents an ambition of architectural design to match the vision of Egmont; a building design which stimulates and challenges and in the process supports students in their personal development and growth. In this paper, we present the result of our evaluation of the project and our analysis of Vandhalla's design potential as best practice of universal design interpreted as a means to stimulate and empower as opposed to compensate and secure.

<sup>1</sup> The Danish Folk high school system was founded in 1844 and today there are about 70 such schools in Denmark. The school is a boarding school for students 18+, offering non-formal adult education, based on the idea of offering a new kind of education to those who did not attend schools for social or economic reasons, and hence strengthen the democratic development of the country ([www.vallekilde.dk](http://www.vallekilde.dk) [accessed 20 November 2016].)

<sup>2</sup> Egmont-hs.dk [accessed 20 November 2016].

<sup>3</sup> Egmont-hs.dk [accessed 20 November 2016].

# Method and research design

The post-occupancy evaluation, POE (Preiser et al, 1988) of Vandhalla was based on fieldwork and the access to written material; the competition brief, the winning design proposal from phase one and two, as-built material and the evaluation report from the members of the competition panel. The approach to the POE and the fieldwork was qualitative. The fieldwork consisted of interviews and walk-throughs. The research interview can be characterised as a professional conversation. Emphasising *inter* and *view*, the result is the construction of knowledge which develops in the interaction between the interviewer and the interviewee. Not to mention the exchange of viewpoints during the conversation (Brinkmann and Kvale, 2015).

Within the process architecture approach, strategies and tools has been developed to involve the users in an iterative workplace design process. One significant tool is 'structured events' characterising activities that create a common understanding and language during a process of user-involvement or an evaluation. *Walk-through* is such a *structured event* (Horgen et al, 1999). Walk-through as a method was chosen in this project in order to create an opportunity to talk about everything we observed during the walk as well as with people we met in the building as we walked through it. Especially in relation to the architect, it was the intention not merely to hear a 'sales pitch' about the architectural design, but also to gain insight into the design process, the competition and the realisation/construction of the building. Regarding the head of school, it was the intention to talk about the use of the actual space instead of the memory of the space, as it is used and experienced in the occupancy phase. Furthermore we interviewed several users whom we met as we walked through the building. The experiences and the stories of the users play a significant role in the evaluation together with photos from the walk-throughs.

A walk-through with the architect from Cubo and a walk-through with the principal were conducted on-site at Egmont. Interviews were also held with three sport instructors, the facility manager, a personal assistant and two students. One of the students had suffered brain-damage; hence the interview was conducted as a conversation between him, his personal assistant and his physiotherapist after a session of fitness training, which we had observed. We furthermore observed students in the swimming pool and talked with them there as well as in the dining hall. The walk-through interviews were later supplemented with an interview with the architect from Force4. The focus was on questions derived from the fieldwork at the Egmont.

Both walk-throughs and interviews were recorded on video and transcribed. The authors have translated the quotes from Danish into English in this article.

# Universal design

Historically, the issue of ensuring accessibility to the built environment has been considered a matter of compensating for lost abilities through design, and in particular with a focus on physical accessibility, which has been described by a number of people. This focus may in part be explained by the historical significant absence of accessibility, hence the priority has been to ensure access rather than demand stimulation and experiences in the process. Salmen showed how accessibility is generally used to describe minimum requirements in building regulations to ensure physical accessibility for people with disability (Salmen, 2001). This understanding of the concepts is confirmed by Ryhl in her analysis of the differences between accessibility and universal design. She furthermore emphasises universal design's potential for including sensory aspects of both functionality and stimulating experiences of architectural space (Ryhl, 2003, 2009). Steinfeld and Danford also describes the mono-focus on accessibility as related to physical aspects of movement (Danford and Steinfeld, 1999) and Iwarsson and Ståhl in their seminal analysis of the concepts in question further underlines how accessibility in general is perceived as descriptive of functioning, functionality and physical access to the built environment for disabled users (Iwarsson and Ståhl, 2003, Ryhl, 2009)

The crucial architectural quality of stimulating the abilities that are functioning, points to the potential of securing sensory experiences or accommodating for sensory functionality as an, to some decisive, alternative to physical functionality. Ryhl in her work (2003, 2009, 2010, 2016) explored and discussed the sensory aspects of universal design as key to the large number of users living with a sensory disability. She introduced the concept of sensory accessibility as a supplement to physical accessibility and a tool to nuance both user needs and architectural design solutions. In her work, she draws on Pallasmaa's seminal work on understanding and acknowledging the role of sensory experiences and stimulation in our general perception of architecture as well as our existential understanding of our being in the world. Pallasmaa underlines the importance of architectural stimulation to human well-being, identity and development and in the process explores the understanding of architectural design, not as a passive frame for our lives but as a dynamic physical and sensory frame with which we are in constant interplay and dialogue (Pallasmaa, 1996)

# A Challenging Space

The concept of a *challenging space* was defined as an analytical tool in the process of evaluating Vandhalla. A concept was needed to describe the characteristics of the space and the interplay between the activity, the architectural design and the pedagogical approach to rehabilitation and habilitation at Egmont. At the same time, the concept was developed on the basis of the empirical material as a reciprocal process. It is described and furthermore used in the analysis of three examples of Vandhalla.

## The concept of a challenging space

Solidarity among the students is a core aspect of the vision of Egmont. It is the aim to challenge the student, assure experience and provide important personal nudges. Because a stay at Egmont concentrates around aspects of development, learning, overcoming and maybe more importantly, being a part of a community – all these elements contribute to making a stay at Egmont exceptional.

When the sport instructors talked about the pedagogical effort, he mentioned Egmont's focus on 'scaffolding' as a teaching approach which at Egmont is related to 'developing through challenging' by finding and upgrading the student's zone of proximal development.

*....the key is always to identify the zone of proximal development and then upgrade it. [teacher and physiotherapist]*

The concept of zone of proximal development (ZPD) was developed by Vygotsky (Vygotsky, 1978). The ZPD characterises the gap between the actual developmental level where the child can perform without guidance and the level of potential development where the child can perform under guidance. Within that span, a certain activity, which would normally be too difficult for a child to perform, can become attainable due to guidance or collaboration with more trained or skilled peers (ibid). Such guidance acts as a kind of support to reach the potential development. It is emphasised that all children have a ZPD that can be evoked. But because the children have different potential for development, there will be differences in their performance (Hasse, 2013).

In addition to guidance from an instructor or peers, the activity was situated and therefore dependent on the qualities of the space. Vygotsky saw the environment as a resource rather than merely as a context (Vygotsky, 1994). The architectural space is a pivotal part of the environment together with the pedagogical practice, and at Egmont it appears that the architectural space in its design as 'a challenging space' is core in the result of Egmont offering the students the possibility to not only be active, but also to challenge their abilities and develop them to reach a higher ZPD.

## Three examples of a challenging space

The first example is the changing area, which included several different spaces and changing facilities. While structuring and designing the changing area, the architects focused on *flow* as the defining design parameter. Due

to the winning teams' focus on equality, they wanted everybody to arrive at the indoor swimming pool through the same door or, as a minimum, same type of door, in order to avoid that people with a disability were referred to a secondary entrance. The client insisted on the need for individual changing 'cubicles' with both toilet and shower described in the competition brief, even though the engineer specialising in swimming pools did not find it necessary to operate with different types of spaces for changing. However, it was important for the client to create the option of a safe and private space.

The design consisted of three traditional changing rooms where everybody changed together. It was possible to open up between the two of them in order to combine them into one for greater flexibility. Six individual cubicles were placed in the transition between the changing area and the main passage leading to the gym and the workout room. From five cubicles, the entrance to the pool area passed through the changing room as a response to the idea about flow and equality. Then everybody enters the swimming pool area from the same doors – the doors to the changing rooms.



Figure 1. A cubicle

The personnel and the students were enthusiastic about the design of the changing zone because they literally saw the flexibility and the possibilities for privacy and security that these cubicles created.

*... and then you can use a cubicle or the big changing room. It depends on how much help you need, or if for example you do not want to show all. (...) it does not exist other places. It is exceptional. [student]*

The cubicles and the traditional changing rooms supplemented each other. For some students it would be overwhelming to change into a bathing suit in a changing room together with other students. But after a while, when the students had changed alone in a cubicle, they would perhaps be ready to use the changing room. This combination of changing facilities was important to the overall vision of offering dignified and respectful situations around the activities of everyday life at Egmont. The changing area offered a space that attempts to accommodate the vision and as such be used to enhance the individual ZPD of every student.

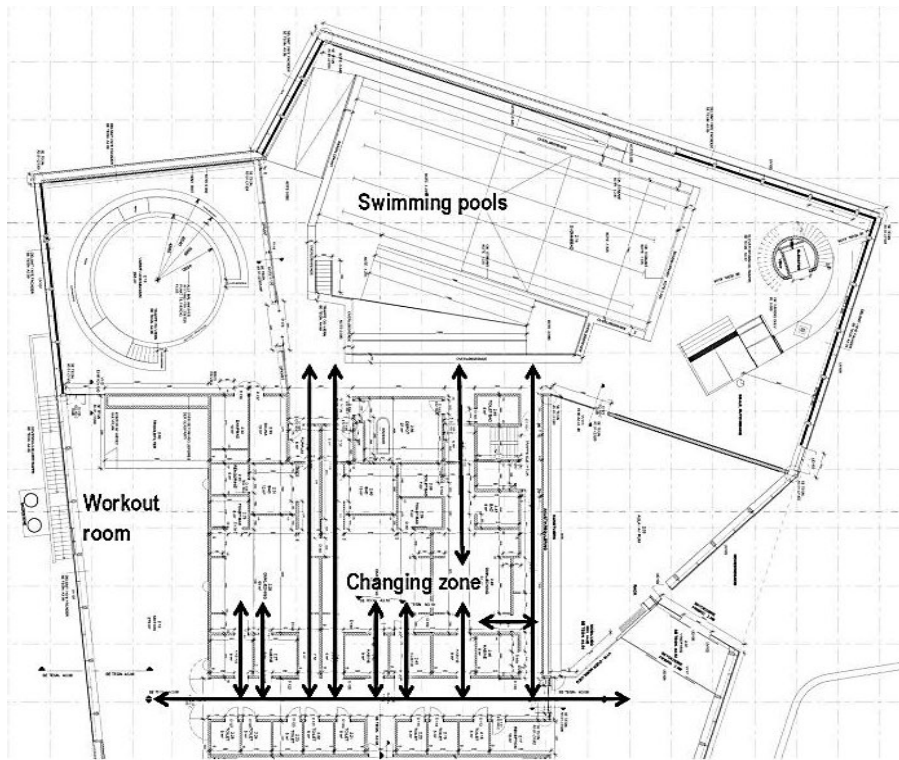


Figure 2. A plan of the changing zone and the swimming pool. The arrows show the flow.

The second example shows the design of the swimming pool and in particular the choice of several different ways of entering the pool. The winning team initially designed one specific solution that should be used by all; a ramp into the pool. This was with the clear intention of creating equality, as their interpretation of equality in design was to design one solution that would work for all. In addition, the team had designed a traditional ladder to access the pool for those who wanted a shortcut and a raised edge that could be used as a transfer seat as well as to sit on when jumping to the water.

However, the competition panel criticised the design proposal with the ramp, as they argued that the ramp's length would be a barrier to using it for some people. Thus their understanding of equality changed and their design proposal changed from one specific solution to a combination of various design elements addressing of the diversity of user needs.



Figure 3. The ramp to the pool.



The different ways of entering the pool was used by the different kinds of users, but also as a tool for individual progression by giving the students a motivational push towards activating their individual ZPD.

*... I have mixed classes where some of the students walk and jumps into the water in the deepest part of the pool. Some of the students lie on a stretcher being driven down the ramp. And others who have difficulty in walking, we encourage to use the stairs. I also have the possibility of initiating a progression about the way they enter the pool.*  
[teacher and physiotherapist]

The third example is the design of the fitness centre/workout room. The winning team designed a workout room that could contain different kinds of equipment. They focused on creating a connection to the rest of the school by establishing a mutual visual connection between the workout room and the swimming pool area and between the workout room and the gym. A lot of natural daylight was prioritised as part of the design too. The client decided to buy equipment that could be used by everyone regardless of their physical condition.



Figure 4. The workout room.

The student Aleks emphasised the benefits of the equipment being similar to the equipment that you would find in a commercial fitness centre – it appeared as a ‘normal fitness centre’. It was the goal that if a student could exercise at Egmont, it would be possible to exercise in a fitness centre anywhere else as well. Furthermore the Egmont participated in the research project ‘Movement lab’ which focuses on creating meaningful activity between people with disabilities and their personal assistant in order to create common experiences and increase the motivation for physical activity by also using new technology for charting the development of the users.

Clearly, the workout room was a success.

*There is much more room for equipment and the so-called ‘torture chamber’ is really something that the students use. Some of them can stay there for hours.* [teacher]

The final design of the workout room appears to ensure different possibilities for exercising which supported the different kinds of users and their individual ZPD.

# Discussion

While Egmont both as a school and as builders set the bar high for universal design and functionality for all, regardless of abilities, the case of Vandhalla documents the possibilities of architectural and universal design as supporting individual growth and empowerment.

If both Egmont and the architects had settled for the traditional understanding of accessibility as a means of accommodating for disability with a strong emphasis on functionality in the narrow way that Salmen, Danford and Steinfeld and even Iwarsson and Ståhl describes the concept, Vandhalla would not have defined the accessible solutions as the rich and varied combination of diverse solutions, as turned out to be the case. Through testing and questioning as well as understanding the high level of diversity amongst users, not only with regard to functionality, but just as much with regard to emotions, safety, security, familiarity and comfort zones, the architects managed to develop new and more complex design solutions specific to both the building and the use/users, resulting in a high level of perceived quality by the daily users of Vandhalla. Furthermore their emphasis on design as sensory stimulation and architectural experiences, they have also shown how universal design may be a decisive component in creating synergy between disability, universal design and architecture.

This understanding of the aspects of architecture which lies beyond functionality, without disregarding functionality, but only supplementing it with more aspects and requirements, is not often seen in relation to accessibility. But through inclusion of emotional, cognitive, sensory and social aspects of architecture, the architects make the leap from accessibility to universal design and even interprets the concept of universal design as a dynamic factor which in Vandhalla is enhanced in quality through stimulating interaction between body, space and pedagogy. Hence universal design is not a passive and pre-fixed design solution, but it is somehow strengthened through use and synergy.

In this article we have introduced the analytical concept *a challenging space* in order to identify how universal design of a space in Vandhalla supported the process of rehabilitation and habilitation at Egmont. It became clear for us that the quality of the space was not only the ability to accommodate for different kinds of disabilities by providing a combination of different designs and possibilities for fundamental activities; to change clothes, to enter the pool, to exercise etc. The quality of the space was just as much its ability to support individual progression in abilities and personal empowerment as it offered different kinds of activities or situations to accommodate an individual ZPD. *A challenging space* as a concept could answer our request for a design concept that would correspond to the ZPD. Because universal design offers not one design solution for all to use, but a combination of solutions, hence accommodating for differences in individual needs and user diversity. It was important to acknowledge that the elements of invitation and security were core qualities of the challenging space at Vandhalla. Our findings point to both elements being decisive to the success of the design.

The spatial encouragement managed to challenge the students along with the factor that the students were able to see what was going on within the space and hence experiencing a tacit invitation to explore the space themselves. Without these qualities, it would have been much more difficult to ac-



compish the positive results in personal development for so many of the students as it appears to be the case after the Vandhalla was inaugurated.

Another aspect of the invitation was the possibility to watch from the outside how other students performed various activities which served as an inspiration for the students choosing first to be passive observers – and as such the design of the space invited to activity – and often an activity that the students had not tried before or was not familiar with. The water slide was an exceptional example of this.

*... as for the water slide, the students are nervous wrecks just thinking about trying it. Then they see someone else coming down it and then they try it themselves. And it is SO amazing to witness. [teacher]*

Another quality was the sense of familiarity – by getting used to the pool it became possible for the students to visit other swimming pools for example when they would return to their hometown or move to live in another place. Furthermore it was the ambition at Egmont that an experience that surmounts apprehension could lead to more physical activity among the students at Egmont because they achieved something that they thought they would never dare to do.

The stimulation of the ZPD was characteristic of the challenging space. Contrary to accessibility which traditionally has been interpreted as a design concept as a means to compensate for the disability – the lack of ability, the idea of a *challenging space* was intended to develop, or even more to strengthen, the existing abilities or using them in the process of assisting the student in becoming more fit or self-reliant. This quality makes it an example of universal design and makes it suitable for all kinds of users.

There can be very individual reasons for being physically active, but for one of the instructors it was fundamentally about enjoyment because the students themselves discovered the real joy of sport. The hope is that this joy will become a driver and that the students also after having left Egmont will be active in sports, not purely because they should, but because they like it. And hence also benefit from the many positive effects of an active sports life documented by eg. Kissow and Johnsen et al.

So while Egmont in Vandhalla in many ways accommodates for accessibility needs as understood in a prescriptive and functionality focused way, documented by several researchers, Egmont furthermore shows how universal design can be interpreted as a dynamic, spatial challenging and sensory stimulating factor enhancing individual development and empowerment. In this understanding of Universal design as a stimulating factor as opposed to compensating, Vandhalla furthermore stands as an example in practice of Pallasmaa's theories of architecture's role of creating human well-being, sensory stimulation, identity, personal development and a sense of belonging in the world – as well as being part of a greater social context.

We believe that Vandhalla through its focus on stimulation as opposed to compensation stands as an important example of the potentials of universal design interpretation as well as an architectural reflection of Egmont's value based vision of individual development and empowerment of their students through challenges.

# Conclusion

Based on an evaluation of Vandhalla, a sport centre, we have proposed the concept of a *challenging space* in order to analyse and describe how the space stimulate and support the student in their process of development and empowerment. Based on three examples of spaces; the changing zone, the pool and the workout room the analysis point at a quality of the space where the space offers different a combination of design solutions that can support individual needs and user diversity and the students individual progression and empowerment. Thus the space as a challenging space stimulates the individual zone of development of each student. Furthermore, it would be relevant to operate with space as a challenging space in healthcare and public health in order to create health and joy of life. We find that this quality of the space is characteristic of universal design as opposed to accessibility where the focus is to compensate for the disability.

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# Health-promotive ambitions related to building design – the case of Angered Nearby Hospital

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## Abstract

*The healthcare system in Sweden is re-orienting and transforming to embrace a holistic perspective on health, which includes a focus on Health Promotion. This development has led to new ambitions and processes in healthcare and has thus changed the requirements for related building design. This explorative study, based on a content analysis of 9 semi-structured interviews with stakeholders involved in the planning and design process of Angered Nearby Hospital (Närsjukhus), investigates how the building design was influenced by Health Promotion ambitions. Questions focused on expectations and challenges for the new building. The results illustrate how Health Promotion was interpreted in the design process and how expectations were described, e.g., as a “welcoming environment” or “active environment”. It is found that the understanding of how to interpret Health Promotion in design is vague and performed without any guidelines other than at the policy level. This lack of clarity is also related to the difficulty of finding studies on the topic. The results also point to a need for clarification of how Health Promotion can be interpreted in design, the need for Health Promotion-related design guidelines, and the need for definitions of requirements at the project level to measure health-promotive effects.*

Keywords: building design, Health Promotion, Nearby Hospital, design ambitions.

# Introduction

This paper discusses the matter of addressing and utilizing the concept of Health Promotion in healthcare building design projects. The paper is based on a study of a new type of hospital being built in Sweden, the so-called Nearby Hospital (Närsjukhus).

## Current health service trends

Previous efforts to improve our health through lifestyle changes and medicine have increased life expectancy worldwide (Burger, Baudisch, & Vaupel, 2012). While life expectancy rates are improving, health and quality of life are not (He, Goodkind, & Kowal, 2016). Furthermore, Sweden is experiencing increasing waiting times to see a doctor, increasing health inequalities amongst populations and within areas, and a disproportionate number of people visiting the emergency department rather than their primary care unit (Anell, Glenngård, & Merkur, 2012). These challenges, in combination with an aging society and an increasing number of people with preventable chronic diseases, require a re-orientation of the healthcare system that includes upstream solutions (Wilson, Harris, Hollis, & Mohankumar, 2010). Thus, a re-orientation from a reactive disease treatment model to a proactive Health Promotion model that includes a holistic view of health (Porter & Department of Education, 2007; Wells & Laguatra, 2009) is necessary.

From a holistic perspective, patients and their health are assessed and addressed related to their resources in their life, including their living environment (WHO, 2009). A holistic model considers a broad biological, psychological and social approach to health and incorporates individuals' needs (Wilson et al., 2010). Healthcare action should also include resources to obtain health and well-being (B. J. S. Nutbeam, Kwok Cho, & Don, 2006).

## Health promotion

An important aspect of holistic healthcare is Health Promotion. Health Promotion is defined as 'the process of empowering individuals and communities to take/get control over their own health' (D. Nutbeam, 1986). While this definition is generally used, Health Promotion includes many dimensions and perspectives (Green & Kreuter, 1999) and is an approach focused on human resources to increase and maintain health, rather than on procedures to treat disease (Antonovsky, 1996). Health Promotion should not be confused with health education, which seeks to inform at-risk individuals about their health-related behaviour (Whitehead, 2004). Health Promotion is related to both public and individual health, including vulnerable groups such as people living with multiple diseases or long-term conditions who are excluded from the regular healthcare system (WHO, 2010). Health Promotion is closely related to care approaches such as person-, patient- and family-centred care. Health Promotion is an integrated part of further development of a high-quality healthcare system, although implementation continues to be challenging worldwide (Wilson et al., 2010).

## The concept of a Nearby Hospital

In Sweden, a new healthcare building typology, the Nearby Hospital, is developing to support the healthcare system, with a focus on delivering equal and accessible care. The Nearby Hospital focuses on delivering care to the local population (Linnarson & Ernstson, 2006; Olsson, 2009) in proximity to their everyday life. It should be able to address 80% of all care needs (Linnarson & Ernstson, 2006; Olsson, 2009), including community health needs, and thus off-load the burden from emergency hospitals (Alfredsson & Nordin, 2006). The Nearby Hospital should not be confused with a primary care unit (healthcare centre/vårdcentral) or an emergency/community hospital (secondary care); rather, it is typologically between those care levels and building types. A Nearby Hospital is characterized by a holistic approach to healthcare that strives for continuity throughout life; emphasizes collaboration between primary, municipal, specialized and medical care; and delivers a Health Promotion approach (Alfredsson & Nordin, 2006) serving people during the day, which requires specialists. Still, since this is new building typology, no guidelines exist for this type of healthcare building (Melin, 2012).

## Healthcare building design

Research by Ulrich and colleagues (2010; 2008) showed that human health could be affected by healthcare building design. Healthcare building design, here, indicates healthcare facility design, both in terms of the design process (activity) and the designed object (built environment). Interpretations in the text will be clarified where needed. Healthcare facilities, here, are buildings facilitating planned healthcare services, such as the primary care centre or the hospital. Studies on healthcare building design have mostly focused on its health effects on individuals, such as patients, visitors and staff (Huisman, Morales, Hoof, & Kort, 2012; Laursen, Danielsen, & Rosenberg, 2014; Ulrich et al., 2008), yet there is limited research on built environments in relation to community health (Aasa & Wikström, 2016), e.g., the effects of the building's design in relation to Health Promotion. Despite this lack of research, the built environment has been noted as an important factor for Health Promotion (Whitelaw et al., 2001). We argue that this research focus could advance discussions on Health Promotion development and on future healthcare facilities incorporating Health Promotion approaches.

## Aim and Research Question

Assuming that future healthcare building design will include more Health Promotion ambitions, this study aimed to explore different interpretations of Health Promotion ambitions and the incorporation of those ambitions into the building design of Angered Nearby Hospital (ANS). A starting point was to investigate how Health Promotion ambitions were perceived by the actors in the planning and design process. The question asked in the study was as follows: How are health-promotive ambitions integrated into the building design according to the actors in the planning and design process?

# Background

The newly built ANS is the first of the Nearby Hospitals and is designed to be a health-promotive hospital. As ANS was the first of this type of hospital, previous studies on Health Promotion and its relationship to building design are limited. A recent literature study in the format of a scoping review led to 15 papers, out of 4506 titles, which discussed the Health Promotion healthcare building design. Those were often implicit in their translation to the building design or were limited to small interventions affecting one aspect of Health Promotion, such as 'active' or 'accessible environments' (Miedema, Elf, & Lindahl, forthcoming).

## The context of Angered Nearby Hospital

ANS is a newly opened Nearby Hospital for the 85,500 inhabitants of Angered, a multi-ethnic low-income part of Gothenburg, Sweden (Alfredsson & Nordin, 2006; Linnarson & Ernstson, 2006). Angered developed into a mass housing area from 1967 to 1972, with further development in 1980. The area faces similar challenges as other mass housing projects in Europe, particularly issues related to income, life expectancy, educational level and health inequality. On average, inhabitants of Angered have poorer life expectancy than inhabitants of other parts of Gothenburg (Lundquist, 2014).

To increase health equality in Gothenburg, its regional and municipal health organizations united in 2005 and initiated a feasibility study for a new hospital in Angered to address the abovementioned challenges. Better collaboration between healthcare and social care and increased focus on Health Promotion should address these challenges. Two main ambitions were defined in the preliminary study (Linnarson & Ernstson, 2006): the hospital should enable a meaningful healthcare encounter in a multicultural area, and it should be planned and organized as a **health-promotive hospital**. In 2006, a pilot study investigated the possibilities of building the hospital, considering the ideas of a Nearby Hospital and Health Promotion.

The planning process was participatory, involving the county council healthcare representatives and municipal care representatives, the architectural firm, and future users of the building. A project manager facilitated several re-occurring group meetings that focused on discussions of needs and wishes for the new building with architects, key actors, department heads, representatives of future users, such as patients and visitors, and inhabitants of Angered. The inhabitants of the greater Angered area and the people working in the area, as well as the politicians, were important actors in engaging and empowering the community.

The design phase, starting in 2011, focused on integrating the two main project ambitions into the design ambitions, which would guide the healthcare building design process (Norden, 2011). The ambitions, as summarized by the design team, were Accessibility, Collaboration, Welcoming, Daylight, Flexibility, Innovation, and Multicultural (Norden, 2011). The construction process then started in 2013 and the building was opened for use in September of 2015. The ANS is the first of three planned Nearby Hospitals in the city of Gothenburg.



# Method

## Study Design

This study involved an explorative qualitative case study on different perspectives of Health Promotion ambitions integrated into the building design of ANS. This involved a content analysis of 9 semi-structured interviews with different actors in the planning and design process, such as the project manager, the initial and final architect, and several future users (see Table 1). The respondents and their quotes have been coded in the results. The study occurred in Angered in Gothenburg, Sweden.

Table 1. Overview of building aspects and categories as mentioned in the interviews

Respondent	M/F	Role	Process phase
AM	M	Initial Architect	Planning and Design
BB	M	Project Manager	Planning and Design
IW	F	Development Manager (utvecklingchef)	Future user
PN	F	Project Architect	Design
HA	M	Public Health Expert	Planning
CB	F	Head of Department	Planning, design, user
HE	F	Acting Head of Department (Tf Verksamhetschef)	Planning and design
VR	F	Research and Development	User
LG	M	Department Head	Design and user

## Data collection

The interviews occurred over a 3-month time period, just before the opening of ANS in September of 2015. Respondents chose all interview locations and the research team developed the questions (see Table 2). All interviews were audio recorded with permission.

Table 2. Questions for semi-structured interviews

Questions
1. What has been your role in the development of the ANS?
2. What will be your role in the new ANS?
3. Tell me about your expectations for the ANS.
4. Tell me what you find important for the ANS.
5. Do you see or have you identified any obstacles to / risks of the project?
6. How do you think we can see/measure those?

## Data analysis

A qualitative content analysis was performed on the individual interviews according to a method described by Charmaz (2014). This included four phases: (1) Transcribing the audio recordings of the interviews; (2) Converting the transcriptions into meaning units and then into condensed meaning units; (3) Filtering the condensed meaning units, including those meaning units that mentioned aspects of the building design; and (4) Coding the filtered meaning units.

## Study Limitations and strengths

As there was no framework to link to, an explorative and qualitative approach was chosen to acknowledge different perspectives. Parameters such as the choice of respondents, number of respondents, and questions asked influenced the results. The respondents involved were able and wanted to contribute. There is a risk of bias as they commented on their own actions. However, the authors do not believe that this has affected the outcome of the study due to its explorative approach. Additionally, as we learned from the results, the questions could be more focused in a follow-up study.

The exploration of an actual case strengthened the study and enabled us to build a platform for studies of other Nearby Hospitals in the years to come, thereby making a longitudinal study possible. Even if the ANS study is not complete in all aspects, it offers a starting point for further studies focused on Health Promotion in relation to the built environment.

# Results

ANS aimed to be a health-promotive hospital that would enable a meaningful encounter with healthcare in a multicultural area. The results present different interpretations of health-promotive ambitions integrated into the building design of ANS, according to actors involved in the planning and design process. From the respondent dialogues on expectations and challenges of designing and building ANS, six categories involving characteristics of the building design re-occurred (see Table 3). These categories can be considered expressions of the health-promotive ambitions that guided the building design of ANS.

Table 3. Overview of building aspects and categories as mentioned in the interviews

Sub Categories by authors	Categories
Active environment	Stimulating healthy behaviour
Environment for health education	
Prevention environment	
Accessible to all population groups regardless of age, disability, cultural background	Inclusive environment (incorporating needs)
Accessible by public transport	
Visibility of the building	
Local health needs	
Welcoming atmosphere (perceived safety, quality services)	Welcoming (incorporation of wishes and values)
Restorative environment	
Wayfinding	
Supporting collaboration (internal, with external departments and with patients)	
Supportive of meaningful encounters	
Getting (enough) daylight into the building	
Ownership and pride of the building	Participatory project process (incorporating empowerment)
Political role of the building	
Symbolism of the building (functions)	
Empowerment	Flexibility of the design to change
Flexible building structure	
Flexible floor organization	
Common spaces	
Flexible furniture for flexible use	

## Comments on building design that stimulates healthy behaviour

Three respondents discussed Health Promotion and linked this to facets of healthy behaviour, either stimulating active behaviour, facilitating health education or areas that include prevention strategies. Stimulating active behaviour is expressed through emphasizing the importance of easy and accessible walking to the building, engaging the patients in physical activities and designing a building where people are presented with solutions that simplify the use of the stairs through location and orientation. One respondent said, 'In a health-promoting hospital we want people to use the staircases (...) the staircases are the first thing you see; we want the patients to walk up to the first or second floor. However, there are also elevators of course' (CB). Another respondent emphasized that Health Promotion should be able to occur both inside and outside the building.

The importance of health education related to the built environment, as mentioned by some respondents, refers to the spaces and functions needed for what are considered health educational purposes, for instance, the educational kitchen for patients to learn how make meals that fit within their new diets. As another example, the interior of the consultation room should be fit for educational purposes and accessible storage of information and books on healthcare. One respondent mentioned that the Nearby Hospital should be the place to go for smoking cessation therapy. The building and its activities should be focused on supporting a healthier lifestyle.

## Comments on building design that is inclusive for all people

All respondents inexplicitly suggest inclusive building design, accessibility for all people, and incorporation of their different needs. Accessibility was highlighted by one respondent as 'everyone can actually access everything, physically or not'. Others expressed that it was important for accessibility purposes that the building be close to public transport, parking and 'everyday life', or remarked on the visibility of the building in the area from the shopping area and from several types of transport used in the area. Accessibility within the building was also mentioned in relation to barriers to physical access, closeness to storage, access to information and opening hours.

Accessibility is also considered by the respondents as a starting point for a welcoming environment and as a basis for empowerment. It was mentioned that there is a need for child-friendly play areas throughout the building and a reception location to support access to different healthcare services.

Understanding the local health needs was also a focus in the participatory design process. One respondent stated, 'In the design process, we focused discussions on the needs of people there' by 'involving staff who could describe quite well the situation of the people living in Angered'.

One respondent mentioned the feeling of ownership as important for the building's accessibility: 'the hospital should be owned by the local population and staff, and therefore have accessible public functions at the entrance level'. This was related by others to the welcoming and empowering environment.

## Comments on building design that contributes to a welcoming environment.

Four of the respondents from the planning and design process explicitly used 'welcoming' in addition to accessibility to describe the ambition for ANS. They related this welcoming ambition to a restorative building design supportive of meaningful encounters, user-centred and respectful of people's background and values, and supportive of collaboration.

When mentioning restorative aspects, the respondents referred to the need for an environment that can reduce stress and make people feel calm before or after an appointment. One respondent described that environment as follows: 'If patients had a meeting that had some bad outcomes, maybe the building can help them to relax before they go home' (AM). One interviewee expressed that 'in the health-promotive building everyone is welcome and patients are helped to find their way (LG)'. Another stated that 'we wanted [the building] to be welcoming because we want the patient to come to us' (...) 'before they are ill' (CB). Six respondents mentioned the need for daylight in the building, corridors, offices and in the courtyards. They remarked on the amount of daylight, being able to look outside, or light used in art installations. For instance, one participant noted that 'we have combined the corridors of the departments, unfortunately with many dark rooms. We used glass panels and glass doors to get some daylight in those spaces' (AM). Regarding the quality of the work environment, a respondent stated, 'I have one of those rooms with glass around (...) And even though it is light enough, I would have liked to be able to look outside' (HA).

Respondents associate welcoming ambitions with the way and where the patient is met. For instance, one respondent mentioned the need for a welcoming examination room 'for the encounter between the patient and the physician' (AM). Additionally, respondents noted that the building should allow for the staff to meet their patients in different ways, even outside of the building. The organization of the building should allow the staff to start their meetings with patients in different parts of the building, e.g., in the entrance of the waiting rooms, depending on the patient's wishes.

A welcoming environment also includes user-centredness with respect to different backgrounds and values. One respondent argued, 'We are individuals, we are unique, we are different and there is no way you can purpose-build for everyone. However, there are certain basic things that you should try to achieve (...) and it is difficult' (VR). The respondents relate the integration of cultural aspects into the building design to building requirements such as facilitation of a spiritual room, a room for an interpreter who can help overcome language barriers, and increased floor surface for the waiting room and consultation rooms so people can bring relatives and/or include them in the patient's consultation. Additionally, they referred to more symbolic features of the building design, such as the art and graphics throughout the building. For example, as one of the respondents said: 'There are no design elements or symbols that refer to a certain population group. For example, the metaphors linked to the gardens are not linked to one religion' (IW). Respondents mentioned that the actors from the local community preferred a Swedish hospital style using warm colours and wood as they argued Sweden is what the community has in common, and the Swedish hospital style was associated with high-quality healthcare.

The importance of the building in improving collaboration was mentioned by all nine respondents. They mention the expected improved collaboration between organizations and departments within the building, such as the collaboration between primary and secondary care, which becomes easier when co-located. One respondent considered ANS as one part of a network

of care buildings in the region (HA). Others worried about excluding research and collaboration partners due to the distance to them, or rather to the closeness to other partners within the same building. Other worries concerned decreased privacy in the building due to shared hallways and confused patients who do not know where to go. However, these issues can be addressed; the confused patients should be helped by the common reception desk, and the respondents agree that collaboration within ANS should increase, as departments share floors, hallways, staffrooms and treatment rooms.

## Comments on the participatory process for empowerment.

According to the respondents, in addition to being accessible and welcoming to all people, the building design should stimulate empowerment and ownership. Six respondents mention the importance of a participatory design process that involved the local population to empower them, create ownership of the new healthcare building and understand their particular health needs. One stated, 'I want them to feel that this is their hospital'. The respondents also relate to pride in the building by the local population and the staff working there. Ownership of the building was related by the respondents to the possibility of being able to influence the environment and personalize it, which could be considered part of ownership. For instance, a pattern found in different building elements, such as the balustrade or the walls, was the result of a local design competition. This gave the opportunity for the local community to contribute to the style of the 'hospital brand', which, according to one respondent, contributes to ownership.

One respondent described the necessity of community involvement: 'some politicians wanted a normal hospital, but the idea [of a Nearby Hospital] disappears without focus on the local population' (BB). Later, the same respondent admitted satisfaction as the building demonstrates 'how their vision is integrated into the hospital' (BB).

## Comments on building design that support changes through flexibility

Flexibility was mentioned by six of the respondents, either as flexibility of the building structure or flexibility in the use of the environment. Flexibility of the building structure was mentioned as the option for extra floors, flexibility of department sizes, etc. One respondent stated, 'ANS has to be flexible, easy to change parts, change the entrance, make departments larger, smaller, and change them' (AM).

Other respondents mentioned different departments using the same rooms, such as the staff rooms, operating rooms or the treatment rooms. Another item mentioned was that the fluctuating number of people attending 'patient's consultation' required larger examination and waiting rooms. The lack of flexibility in use was described by one respondent: '[the new workplace is] tricky because it is designed [so] a table should be (...) [next] to that wall. I do not like to have my computer [near] to the windows' (IW).

# Discussion

Beginning with the mapping of respondents' comments and assuming that future healthcare building designs will also include Health Promotion ambitions, this study has explored ANS and how, according to the respondents, Health Promotion ambitions were integrated into the building design.

When reflecting on the responses, we discovered the main Health Promotion ambitions in relation to the healthcare building as an object: it should facilitate healthy behaviour; it should be accessible and welcoming, thus incorporating the needs and values of its users and populations; and it should be flexible and adjusted to the local context. Furthermore, the design process should contribute to community empowerment within the local environment.

While familiarizing ourselves with the interviews, we noticed that all respondents agreed that Health Promotion is more than stimulating healthy behaviour, meaning they have not reduced Health Promotion to health education, which is a common issue described by Whitehead (2004).

Additionally, we learned about the need for the building's organization to support health-promotive ambitions. Thus, it should be inclusive, without any type of barriers, and should support collaboration between healthcare services for the advantage of users. It was noticed that the respondents considered a health-promoting hospital as one that is embedded in the local context, includes the surrounding population as possible users, patients, visitors and staff, and considers a variety of their different needs rather than only their health needs. The multicultural demographics of the area make the consideration of different needs and values especially important.

We realized the importance of an inviting character when the community wants people who are not in need of treatment, but could benefit from an interaction with healthcare, to come to the building. In addition to being available and accessible, this type of building should also be inviting. This understanding relates to the proactive approach of health-promoting hospitals as described by Wells and Laguarda (2009).

Furthermore, we perceived that the respondents recognized the importance of a participatory building design process as a tool to understand the population needs for community empowerment. In addition, although this was not the focus of our study, it seems as if a Health Promotion-focused building design is challenging to accomplish without such a participatory process.

Finally, we learned that there are several possible roles for building design in promoting health in addition to facilitating Health Promotion activities (health education), such as supporting Health Promotion processes, reflecting Health Promotion organization (co-location and collaboration) or symbolizing Health Promotion ideology (a building close to home).

# Conclusion

It has been shown that Health Promotion in building design includes a range of building design interventions that, combined, can have several results for the building design. The minimum result is facilitating Health Promotion action (such as health education and physical activity). Additionally, supporting a Health Promotion organization that is user centred and non-excluding is important. Further, an environment that invites people who are not in need of treatment, but may need care, should be considered. The building design should also consider the local context, thus reflecting the needs and values of the surrounding population. The relation of Health Promotion to building design also has a much more complex relationship when considering all aspects of everyday life. To what degree should the built environment intervene in how we live? For example, today, the building of bike lanes is not a single-issue question but rather a question that touches on political, Health Promotion, urban design, energy and environment issues. This complexity remains important when considering Health Promotion and building design.

## Practical implications

Constructed from this study, a few concrete suggestions for building design emerged, as summed up in the list below.

- Facilitate health-promotive functions and healthcare services that reflect the local health needs, thus making healthcare available for the local population.
- Make it possible for all people to use the building. It should be accessible for all, for staff, patients and visitors, including those with different health needs.
- Create a welcoming environment. That is, in addition to being accessible, the building should be stimulating and motivate people to come even if not ill. It, therefore, must be respectful of differing cultural backgrounds and their values.
- View the process as a tool to empower people, create ownership and to be able to understand their specific needs.
- Focus on building design features that stimulate healthy behaviour and healthy choices.

However, these points address different aspects that all must be integrated during the actual design work. Moreover, they must be related to the context of the design, not least if utilizing an Evidence-Based Design approach.

## Further research

The field of Health Promotion and its relation to building design and the built environment in general needs to be further studied. With an increased number of policies and projects incorporating the Health Promotion approach, there will be a need to define, discuss and develop how this can be articulated to be included in building design processes.



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# How can research on patient experience inform hospital design?

## A case study on improving wayfinding

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### Abstract

*For patients a hospital visit is a profound experience influenced by their mental and physical state in that moment. Various aspects of the hospital environment play a role in their experience. For most patients communicating about this experience in all its complexity is a difficult task. This difficulty impedes designers' and hospital professionals' insight into patients' perspective on the hospital environment.*

*For this reason we are investigating how research on patient experience can inform hospital design. In this paper, we explore more specifically (1) how insight into patient experience can foster an empathic and motivated understanding amongst healthcare professionals and designers, (2) what kind of information is needed to achieve this, and (3) how their improved understanding impacts on their problem solving ability. To this end, we report on a case study in collaboration with a general hospital, with which we organised a series of workshops about improving wayfinding.*

*Bringing together different profiles of designers and healthcare professionals turned out to be an enrichment for all parties involved, even when working within the same organisation. Depending on their profile, participants had different expectations of the format and content of the information presented during the workshop.*

*Although the workshop was generally evaluated positively, specific attention should be paid to raising realistic expectations about information on patient experience. We found a discrepancy between what research can tell about real patients' experience, what healthcare professionals expect to learn, and what is useful for designers to work with.*

**Keywords:** Hospital design, Information Format, Patient experience, Wayfinding.

# Introduction

For patients a hospital visit is an intense experience. Although familiarity with the environment, anxiety, stress level, and physical state can differ significantly, almost no one visits a hospital completely voluntarily. Staff experience the building from a professional angle: it is their daily work environment which they are highly familiar with. These divergent perspectives impact on how both groups consider and navigate the building. This became particularly clear when studying the case of a general hospital where wayfinding appears to be a major issue.

Prior research involving actual patients and volunteers exploring the hospital building, showed that various aspects of the hospital environment play a role in patients' experience of wayfinding (De Valk, 2015; Weustenraad, 2015). For staff it is not always easy to imagine or even be aware of patients' difficulties in navigating the hospital. Most patients find it hard to communicate about their experience in all its complexity (Annemans et al., 2012). This impedes designers' and hospital professionals' insight into patients' perspective on the hospital environment.

The case study on wayfinding we report on in this paper is part of a larger project in which we investigate how research on patient experience can inform hospital design. In this paper, we explore more specifically (1) how insight into patient experience can foster an empathic and motivated understanding amongst healthcare professionals and designers, (2) what kind of information is needed to achieve this, and (3) how their improved understanding impacts on their problem solving ability. After sketching the background of the overarching project, we explain the approach adopted in the case study. Subsequently, we present insights in reply to the questions above. We then discuss to what extent the approach was successful and what lessons can be learned about informing hospital staff and designers on patients' experience. We conclude that a discrepancy exists between what research can tell about real patients' experience, what healthcare professionals expect to learn, and what is useful for designers to work with.

# Background

Various studies show that the environment – products, services, and spaces – has a significant impact on patients' wellbeing and as such can add to their healing process (Ulrich et al., 2008; Huisman et al., 2012; Desmet & Pohlmeier, 2013). Most designers and hospital staff are convinced of this impact but often lack accessible information offering a nuanced insight into patients' experiences. Ideally this information is obtained through interaction with real users, allowing the designer to develop a more thorough understanding of and empathy with them (McGinley & Dong, 2011). However, since time and money restrictions in a typical design process often result in a minimal user engagement (Cassim, 2010), designers are often unable to obtain this direct input from users and become dependent upon indirect sources of human information (McGinley & Dong, 2011).

As designers often do not have direct contact with the people they are designing for, various techniques have been developed to bring them closer to these people's experience (Kouprie & Visser, 2009; McGinley & Dong, 2011; van Rijn et al., 2011). These techniques vary from having direct contact with real people, over consulting videotaped observations or interviews, to being presented with profiles of imaginary persons. Most of these techniques aim to foster empathy. In the case of vulnerable groups like hospital patients, practical and ethical restrictions make it hard for designers to actually engage with them.

Experiential user information like ethnographic data collected in various (health)care settings, both hospitals and (residential) care facilities, could provide hospital staff and designers with much of the needed information to gain insight into patients and residents' experience and to empathize with them. Yet the scientific articles this research is mostly presented in, are not the number one source where designers look for information (Annemans et al., 2014). Possible explanations are that designers are rather motivated by visual communication and like information to be presented graphically (Loft-house, 2006) or that they often feel mistrust towards data that have already been interpreted (Restrepo, 2004). They claim to prefer raw data in a format that is condensed down to be design-relevant (McGinley & Dong, 2011). On the other hand, architects are often inspired by other architectural projects, whether consciously or not (Heylighen & Neuckermans, 2002).

# Approach

## Context

The case study reported on here took place in a general Belgian hospital. The hospital in its present form results from a fusion between two hospitals located at the opposite sides of a street. With the fusion the distance between both needed to be bridged, which was realised literally by building a covered bridge over the street to connect the two buildings. This, in combination with the organic growth of both buildings over time, created a hard-to-understand building layout, causing considerable wayfinding issues.

The current wayfinding system, overruling all previous ones, makes use of numbered streets, with numbers having no direct relationship with floors or corridors. Scattered around the buildings are traces of former systems, like coloured corridor crossings. Although the numbered street system is theoretically well thought through, it is not always experienced as such by patients and visitors who are unfamiliar with the building, and are often in an anxious or nervous state of mind.

To prevent mistakes, reception staff are only allowed to give the route number and an explanation on how to follow the arrows. Other staff often have a limited understanding of the numbered routes, as they still think about the hospital in terms of its former numbering with letters for different buildings and floor numbers in each building.

## Study Design

The presented case study is part of a broader case study enquiry. A case study is defined as the study of a case (person, place, event), selected for its particularity, and 'bounded' by physical, temporal, social/cultural, and conceptual features. Case studies are the preferred strategy to gain an in-depth understanding of a contemporary phenomenon in a real-world context (Yin, 2012; Flyvbjerg, 2006). In this case we studied a fusion hospital confronted with a particular wayfinding issue and aiming to obtain an in-depth understanding of the problem as well as to take steps towards formulating possible strategies to tackle the problems the hospital is facing.

The case study we report on consists of three workshop sessions in the hospital with a variety of staff members. Each session took half a day and session 2 and 3 were organised in one day.

### Session 1: Identifying problems

The first session focused on identifying problems with regard to wayfinding from a patient perspective.

After participants expressed their personal issues with (the) wayfinding (system), their attention was shifted towards the patient perspective. To this end, we loosely applied the persona's technique often used in product- and service design (Pruitt & Grudin, 2003; Nielsen, 2013). This technique allows designers to base their decisions on fictional people's goals and activity scenarios, thus taking into account a broader user groups than only those similar to themselves (Pruitt & Grudin, 2003). The workshop started with a group session to identify an example of a patient visiting the hospital, then partici-

pants were divided in small team and each team was challenged to create its own patient profile. Most important was the person behind the patient: pathologies or reasons for a hospital visit were taken in consideration only after a person profile was created. To diversify the routes through the hospital each group could pick a card with information on why this person visited the hospital.

To foster their empathy with patients and thus improve their insight into their wayfinding experience, participants were asked to follow the assigned route through the hospital, trying to perceive it from the perspective of the person they had created and to document it through pictures. At the end of the session each team was asked to present their route and to identify problems they encountered with regard to wayfinding.

## Session 2: Offering insight into wayfinding based on experiential user information

In the second session participants were offered experiential patient information through a website. The website encloses a combination of theoretical knowledge and insights into (the experience of) wayfinding (fig. 1). This is achieved by connecting data fragments from qualitative research on patients' wayfinding experience with theoretical concepts on wayfinding.

The homepage of the website gives a short introduction on wayfinding. This theoretical part shows the reader that wayfinding is about more than just signage. Also architecture and communication play an important role in guiding patients to their destination. From the homepage the reader is directed towards four profiles of patients navigating a hospital. Each of these profiles is documented by video-recordings of the patient's route through the hospital and quotes from interviews with the patient. When relevant, the profiles are complemented with similar insights from other patients.

During the first part of the session participants were given the opportunity to explore the website. Thereafter, they were asked to pick at least three pictures they had made in the first session and to re-evaluate them based on the new insights they gained from the concepts and experiential information offered through the platform.

**Zo?Zo!**  
Van zorgzaam onderzoek naar zorgzaam ontwerp.

Wayfinding

**Profiles**

CASES

- Case: Francis
- Case: Jakob
- Case: Johan
- Case: Karin

ZOEKEN

Zoeken ...

**Karin - Communicatie - Gesproken Communicatie**

De uitdaging bij het ontwerpen van hulp van medewerkers onderweg belooft de verwachting van bezoekers en patiënten sociale interactie. Goede uitdaging zorgt voor realistische verwachtingen en een gevoel van begeleiding (herkenning) tijdens de route.

**RESTEMMING: In verband met...**

"Wat me wel opvalt is dat het medewerkers loopt hier gewoon zijn weg en het nodigt niet uit om te vragen 'oh waar moet ik zijn?'"

Het is niet voor iedereen makkelijk of fijn om iemand aan te spreken voor hulp. Karin zegt hierover het volgende:

Wat me wel opvalt is dat iedereen hier gewoon zijn weg loopt en het nodigt niet uit om te vragen 'oh waar moet ik zijn?' (...) als mensen inderdaad verloren gaan lopen, wat ik me voor kan stellen, dat je je belemmerd voelt om te vragen, 'waar moet ik naar toe?'.

Ik zou het hier bijvoorbeeld niet weten hebben, aan wie ik dat hier zou kunnen vragen. Iemand in het wit, maar. Nee ja... Dat viel me wel op inderdaad, dan zou ik het niet geweten hebben. Dan zou ik inderdaad hier naar de balie gelopen zijn 'waar moet ik naar toe?'.

Ook voor Aurij, Loris en Jakob is het niet vanzelfsprekend iemand direct aan te spreken:

[Interviewer] En u ging ook eerst zoeken op de informatieborden, heeft u een voorkeur om dat eerst zelf te zoeken eer dat te vragen of u dat...

**Theoretical background**

**Video recording with subtitles**

**Interview excerpt**

**Complementary audio recording**

Figure 1. Example of a profile on the website.

The assignment was structured following a step-by-step approach:

1. Identifying bottlenecks
2. Analysing bottlenecks through the application of theoretical concepts
3. Weighing possible solution strategies against one another

By following these steps, certain locations where multiple concepts were relevant were identified. (Spatial) elements from which a wayfinding issue originated or which could serve as a trigger to improve the situation were then documented.

### Session 3: Generating solutions

The third session was solution oriented. Based on the insights gained by the analyses made in the previous sessions, participants, in dialogue with the researchers, now explored possible solutions to the wayfinding problems that suit the concrete context of the hospital.

## Participants

Workshop participants were recruited by the hospital in consultation with the researchers. We aimed at a broad variety of staff profiles dealing with wayfinding or the wayfinding system from various angles. The first session was attended by nine persons:

- facility manager
- head of the building department
- employee of the building department
- employee of the prevention service
- patient administration processes manager
- employee patient administration processes (= reception staff)
- employee patient transport
- employee logistics
- security staff

For the second and third session this group was complemented with two additional persons:

- reception volunteer
- nurse.

Although all participants work in the same organisation, this variety of people had never before met to discuss the working of the hospital on an equal footing.

## Data collection and analysis

The three sessions were led by two researchers (author 1 and 2) who alternated in leading the discussion and observing. All group discussions were audio-recorded. When participants were working in teams the researchers provided support and observed group dynamics and registered conversations. The pictures taken by the participants in the first session were collected and used both to analyse the outcome of the first session and to serve as a starting point for the second session.

The analysis started right after each session with a first discussion between the researchers about the issues at stake regarding (1) the desired and used content in relation to the format in which it was offered or generated, and (2) the approach of the workshop. Observations and evaluations were noted down and taken into account for the next session.



# Findings

This section discusses the workshop findings on the basis of the questions outlined above: (1) how insight into patient experience can create an empathic and motivated understanding amongst healthcare professionals and designers, (2) what kind of information is needed to achieve this, and (3) how their improved understanding impacts on their problem solving ability.

## Fostering an empathic, motivated understanding

Wayfinding is clearly a key issue in the hospital which most of the participants are confronted with on a daily basis. Not only does staff's experience differ significantly from patients', participants each had their own vision on the current wayfinding system and according communication. The origin of the divergent view on wayfinding can be found in how the building is approached by staff and how this differs from how patients are expected to make use of the wayfinding system. Staff are often familiar with multiple parts of the hospital, which offers them an overview, whereas patients and visitors have a more fragmented experience as they come in contact with only parts of the hospital. Moreover, most staff members still think about the hospital in terms of the former system of buildings and building blocks, and not in terms of the present routing system. This leaves them often unable to support patients in following the routing system.

Staff members' sensitivity towards the patient perspective differed depending on their professional profile. Especially those who designed and implemented the current routing system had difficulties understanding why wayfinding was so problematic for patients and visitors. Given their overall understanding of both the building and the system, they clearly saw the coherence and logic, and were unable to zoom in on patients' more fragmentary experience of the building. This resulted in a mistrust towards patients' ability to navigate the building. Frequently heard comments include *"People don't take the time to understand the logic behind the system"* and *"I don't know whether you help patients by saying the floor [they have to be on], because then they surely take the wrong elevator"*. Reception staff were very well aware of the troubles patients were facing, being unable to read the ranges of numbers and feeling lost when they could not immediately spot the next sign. For them the enforced communication style, telling them not to give more information than the route number, caused considerable frustration.

When participants were asked to create a patient profile from whose perspective they would explore the building, all four groups opted for a vulnerable person. Three teams created a refugee (probably due to moment of the case study, at the height of the refugee crisis in Europe), unable to speak the language and completely unfamiliar with the building and common procedures. The fourth team opted for a confused older man. By following the route these people would take when dealing with the health problems according to the corresponding scenarios, participants were confronted with issues they had formerly not considered:

- Patients are highly dependent on staff to get started with the routing system especially when not following a standardized path, *i.e.* entering via the emergency department or having missed a bus stop and approaching the building from a different street.

- The current wayfinding system is designed from the perspective of a standard patient; one flaw -not understanding the language, not using the lift because of claustrophobia, or just being too stressed to listen to the instructions- can result in getting lost.

By navigating the building from a patient's perspective, participants experienced the flaws in the routing system first-hand. The current wayfinding approach strictly aims at guiding people to their destination completely based on signage, without supporting them in understanding where they go. Once you miss a sign or lose track of the numbers, there is no other option than returning to where you came from. This is reflected by the pictures participants took while following patients' routes. A majority only showed signs and arrows, picturing nothing more than the ceiling and the upper part of the walls (figure 2). Architectural elements were hardly ever recorded. Only when looking at the pictures participants realised their limited focus. The few images showing people and views of the environment were taken when they had lost track of the signage. Participants stressed that at these moments they particularly appreciated encountering (personal) support and orientating elements.

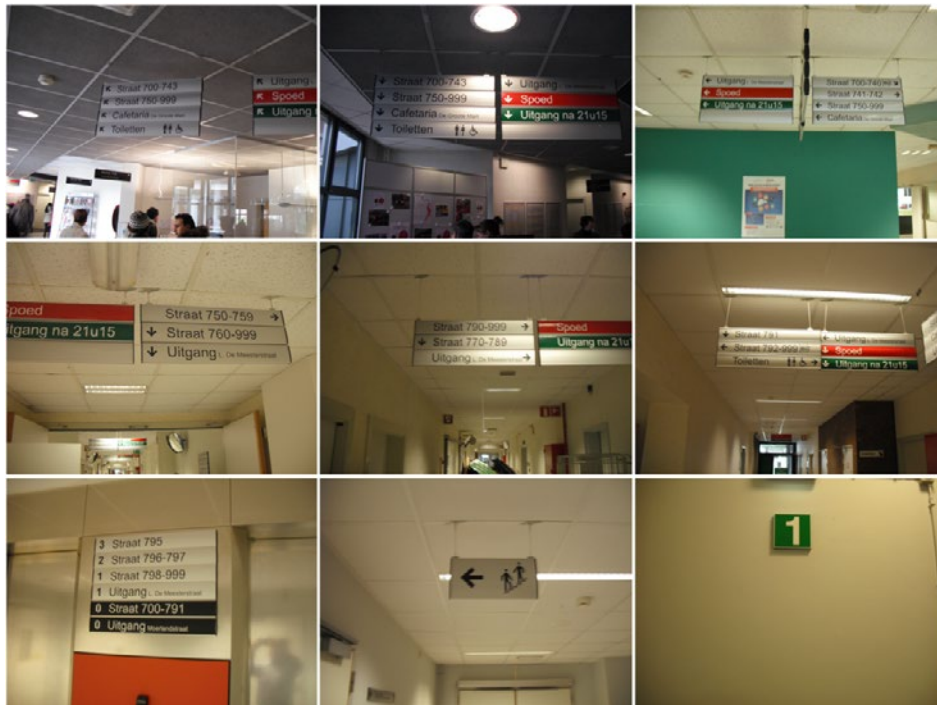


Figure 2. Sequence of 9 consecutive pictures taken by participants only showing signs.

Concentrating on the upper part of the hallways limited the opportunity for participants to actively use the built environment as support in navigating the building. Exploring the website helped participants realize that orientation is an important element in wayfinding. The website offered a whole section on how the built environment could support orientation, based on both theoretical concepts and visual material showing how people navigated another hospital.

## Types of information and techniques

The technique offered in the first workshop to create patient profiles, supported participants to think about the particularities of those experiencing wayfinding problems. It seemed an excellent preparation for empathizing with vulnerable hospital users and actually being open to perceive the building from their perspective. This change of mind-set –moving from being oc-

cupied with their own view on, and frustrations with the wayfinding problems— appeared to be a necessary step to be able to evaluate the building from a patient perspective.

The website offered various types of information, each holding its own value to sensitize and motivate participants to obtain a better understanding of patients' wayfinding experience. The introduction page explained certain theoretical concepts which were then further developed on the next pages showing real patients dealing with wayfinding in a hospital. Links between the patients' experiences were also made based on these concepts.

When asked about the most relevant information type, participants pointed at the video material. Especially appreciated were side-by-side videos of a hallway respectively with and without people, complemented with an explanation of how this was experienced differently by patients. Participants claimed that the theoretical framework was not that appealing and added little to motivate them or enhance their empathetic understanding of wayfinding. Yet, in the following discussion and search for solutions, they often used the concepts offered through the theory. Although not valued explicitly, offering these concepts apparently seemed to provide the workshop participants with a common vocabulary to discuss certain issues that appeared during their exploration of the building and/or while watching the patients' video's or reading their testimonies.

Understanding patients' experience and empathizing with it is one thing, formulating solutions to improve the situation is another. Connecting the offered theoretical concepts with concrete locations in the hospital was not sufficient to actually be able to formulate clear cut solutions. When asked what would support them in coming up with these solutions, above all participants suggested examples of best practices.

## Impact on problem solving ability

Generating solutions was not a natural next step after the evaluation of the hospital building and its wayfinding system. Especially considering the familiar environment with an open mind appeared to be challenging. The current system was strongly defended and change encountered serious opposition by the employees of the building department. Yet, making use of the self-created patient profiles seemed to be an eye opener. References to the wayfinding experience from these patients' perspective and the pictures taken along their route were made: *"I think there are pictures of the place where people go to [destination X] that's indeed a very difficult point, we saw that."* Also the experiential information on wayfinding experience in a different hospital was used to think about possible solutions. Participants referred for example to the use of a map to provide patients with something to hold on to and help reach their destination.

Before the workshop, participants each reflected on wayfinding from their own perspective and did not seem to connect these perspectives to create a mutual understanding. The shared vocabulary offered through the theoretical part of the website and appropriated through the assignments appeared to be an important basis to start a dialogue. Whereas the strict instructions on how to communicate on the routing was a thorn in the side of the reception staff, for those who designed and implemented the system it was unthinkable to change it. Offering the participants insight into how signage, architecture and communication work together to mediate patients' wayfinding experience in combination with a better understanding of the diversity of patient perspectives, seemed to open their minds to rethink one-sided assumptions

and see the value of extra interventions that may not exactly fit in with a wayfinding system based on numbered streets only.

Only during the discussion, guided by the researchers, participants seemed to be able to connect the different types of information offered through the website. At this point they combined theoretical concepts with the experience of following the patient scenario's. This resulted in the creation of a "spine" through the hospital, i.e. the route from the entrance of one building to that of the other building. The spine should not be used to actually follow the entire route but could function as a point of recognition to return to and depart from again. Also certain intersections and vertical circulation could benefit from being more explicated.

Reflecting on the three workshops, participants concluded that when consciously designed, signage and more implicit spatial interventions can complement and strengthen each other. Creating an integrated approach which combines architecture that directs people while moving through the building with a communication strategy that supports patients and visitors throughout their journey holds potential to enhance rather than endanger the functional system that is now in use.

## Discussion

Despite staff's good intentions to be helpful and supportive towards patients and visitors, many of them did not realise how far their use, understanding, and experience of the hospital building diverted from patients'. As some of the participants often come in close contact with patients and visitors experiencing wayfinding problems, think of reception staff or volunteers, this group could express some of patients' grief. Yet, none of them actually had ever followed these people's routes. Additionally, they were confronted with regulations imposed on them regarding what they could tell patients and visitors and how far they could go in offering support. Whereas these communication guidelines were formulated with the best intentions with regard to the efficiency of the wayfinding system, i.e. only following the signs, there was no common understanding on why and how this conflicted with patients' and visitors' intuitive approach to and experience of navigating the building.

Fostering empathy with patients by making staff walk in their shoes, created a first impression of patients' perspective amongst the participants. They noticed how dependent they were on staff members' willingness to put them back on track once lost. The (lack of) communication in various forms, be it spoken, written, or through the building, even left them in despair regardless of their familiarity with the environment. The pictures they took of the followed route, only showing signs, ceiling and the upper part of the walls, pointed at the dependence on signage, and the lack of attention to additional (building) elements that could support orientation and navigation. Being unable to literally open doors they would normally use, provided them with a whole new perspective on the (lack of) coherence of the built environment. Obtaining this embodied understanding seemed to motivate the group to further collaborate on solving the issue, uniting each member's previous personal concerns and perspective on patients' and visitors' experience.

In obtaining a better understanding of the wayfinding problems in the hospital, participants felt especially supported by the video-recordings offered through the website in the second session. In the third session, they frequently referred to them connecting concrete situations from the videos with their own experience. An important advantage of the video's (combined with a textual explanation) seems the opportunity to offer nuanced insights in a compact way. Still, when asked to analyse the pictures taken in the first session by connecting them to theoretical concepts offered through the website, participants seemed to hesitate. Only consulting the website was not considered sufficient to analyse and identify bottlenecks in the hospital's spatial organisation. To achieve this participants demanded very concrete, and guided tasks.

The combination of embodied experience with fostering empathy seemed to convince participants of the added value of integrating architecture, communication, and signage to improve wayfinding. The presented information, combining theoretical concepts with visual material and narratives on patients' and visitors' wayfinding experience, raised their awareness of the problems patients were facing and helped them to analyse the existing situation, but did not seem to support them in finding solutions. To this end, participants suggested providing best practices, i.e. examples of good solutions. This is in line with the outcome of previous research pointing at architects' case based design approach (Heylighen & Neuckermans, 2002). Apart from the fact that providing this type of information lay beyond the scope of the project, we are concerned that showing these examples could also hamper participants' out of the box thinking.

# Conclusion

The case study shows how, apart from providing experiential patient information, guidance and initiative by an external moderator provides an added value to exploring the experiential by themselves. Although all participants were working within the same organization, it took a third party to bring them together to collectively discuss a common topic. Doing so turned out to be an enrichment for all parties involved. This value was confirmed by the participants as they planned to continue collective meetings to discuss this and other topics concerning the hospital's (spatial) organization.

Depending on their profile, participants had different expectations of the format and content of the information presented during the workshop. For some empathizing with patients was truly eye-opening, for others just a confirmation of what they dealt with on daily basis. Letting go of the strict signage approach and according communication was for some a relief, for others a heavy duty. Starting from a shared understanding of the issues at stake, generated through the session to foster empathy and the video-recordings and supported by a common language provided through the theoretical concepts, created a basis for collaboration between staff members with distinct profiles.

Although the workshop was generally evaluated positively, specific attention should be paid to raising realistic expectations about information on patient experience. What research can offer, what hospital staff expect, and what is most fruitful to support design does not always coincide. Particularly in the case study presented here, we found a discrepancy between what research can tell us about real patients' experience, what healthcare professionals expect to learn, and what is useful for designers to work with. In the overarching project the insights gained through this case study will be combined with those from others to add to our understanding of how research on patient experience can inform hospital design.

## Acknowledgements

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# How cancer patients and relatives experience specially designed cancer counselling centres

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# Abstract

It is a fact that design of healthcare institutions which accommodates the users, is the key to clinical, economical, functional and experienced satisfaction. Architecture can among other elements affect stress, quality of sleep, anxiety, wellbeing, comfort but also time of hospitalization and healing of patients in healthcare institutions.

Six new cancer consultation centres “Livsrum – space for life” are created and taken into use during 2013 – 2014 in Denmark. This is centres where cancer patients and their relatives can seek help and support when they are dealing with cancer. All centres are based on the same design guidelines and staff, volunteers, patients and relatives from each centre have been involved in the process of developing them.

This paper aims to investigate how patients and relatives experience the architecture of the six new cancer consultation centres and how they interplay with the supporting activities in the centres.

The paper is created as a post occupational evaluation, where architecture is evaluated when in use. The empirical data is collected from focus groups with patients and relatives, participant observation, and architectural observations.

The patients and relatives describe the centres as warm, cosy and friendly, and they experience a homely atmosphere. This is especially linked to the design and interior of a shared space, working as a waiting area and created as a living room. The soft, nice looking, interior with different furniture, views to nature and specific settings (kitchen and lounge) are important to their positive experience.

Staff and volunteers impact the patients and relatives experience as well, which is central to their understanding of how they can and may use the centres. The design also affects the interaction between patients and relatives. This is seen in the living room where some patients and relatives enjoy socialisation but others lack privacy.

*Keywords: user evaluation, cancer patients, cancer counselling centre*

# Introduction

That healthcare architecture accommodates the needs of the users seem like an obvious requirement. However, many other elements affect the design of a building especially the design of architecture related to the healthcare sector and the needs of the users can be forgotten in the design process (Ulrich 2000; Knudstrup, Harder & Møller 2007; Knudstrup 2015; Lemche 2012).

In Denmark six new cancer consultation centres (Livsrum – space for life) are created in Aalborg, Herning, Vejle, Odense, Næstved and Roskilde and taken into use during 2013 – 2014 (Figure 1 to 18). Cancer patients and their relatives can seek help and support when dealing with cancer in the centres. With inspiration from the cancer centres in the United Kingdom called Maggie's Centres, these new centres are created in a design representing something else than a common healthcare institution (Arkitema 2008). In the development of the Danish centres, the needs of staff, volunteers, patients and relatives were taken in account as well as an awareness of all the supporting activities. This was done through consultations and meetings with all groups of users to make sure the design accommodate their needs. Each centre was designed individually, but all of them are modelled upon the same design guidelines (Arkitema 2008). These guidelines describe that the main purpose of the design of the centres is: *“That the architecture itself, and in interaction with the activities, can help cancer patients and their relatives with the psychosocial aspects of dealing with cancer”* (Arkitema 2008). The guidelines describe the general vision of the architectural design of the centres but also the specific rooms needed, their sizes and the elements within them.

This paper is based on an evaluation of the six centres completed in 2016 (Falk et. al. 2016). The main purpose of the evaluation was to investigate, how the patients and relatives experiences the centres reflect the visions in the design guidelines. Within this lie an investigation of the actual build architecture, the flow patterns, daily life and the user experience of the centres and whether it accommodates the users' needs. An interdisciplinary team of sociologists and one architect (the authors) carried out the evaluation at REHPA - Danish Knowledge Centre for Rehabilitation and Palliative Care. The researchers had no earlier involvement in the centres. The evaluation was financed by Realdania and was a result of a corporation between The Danish Cancer Society, Realdania and REHPA.

The users in focus in this paper are defined as patients suffering or having suffered from cancer, relatives to cancer patients and relatives having lost a loved one to cancer, who are using the centres. The staffs opinion and experience were not in focus. However, the staffs' impact on patients' experience of the physical environment was investigated, as a natural consequence of them being in the buildings. In this evaluation of the physical environment the focus was on the near surroundings of the centres, the architecture and the interior within.

Pictures and plan diagrams out of scale are seen in figure 1 to 18.



Figure 1. The front façade of the centre in Aalborg.



Figure 2. The living room in the centre in Aalborg.

Figure 3. A diagrammatic plan drawing of the centre in Aalborg. This centre is drawn by the architectural office Polyform. The centre is in one floor and covers 695 m.

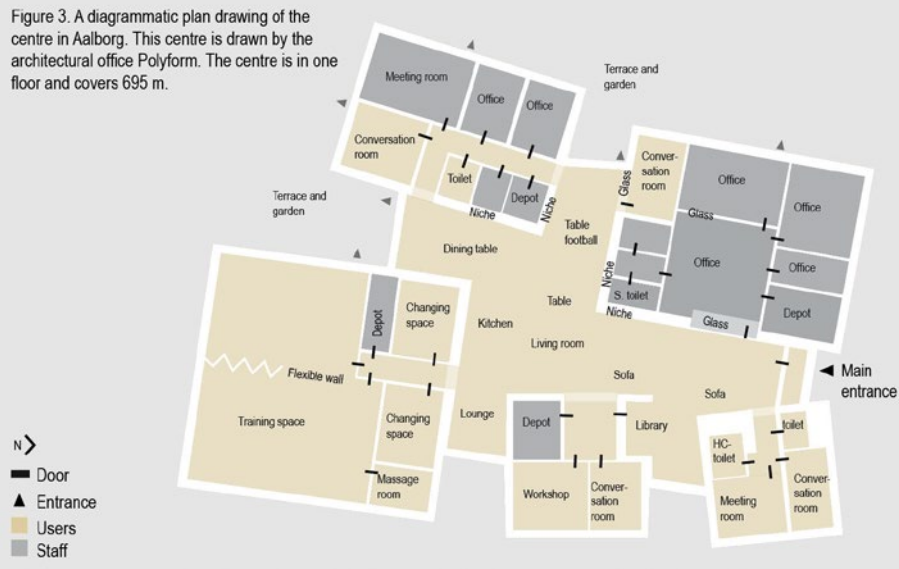


Figure 4. The front façade of the centre in Herning.

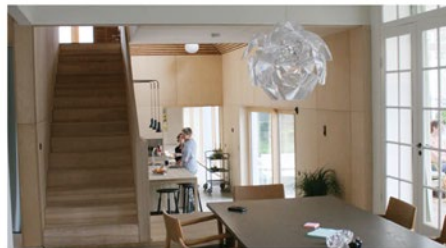


Figure 5. The living room in the centre in Herning.

Figure 6. A diagrammatic plan drawing of the centre in Herning. This centre is drawn by the architectural office Claus Pryds. It is in 5 levels and covers 453 m².

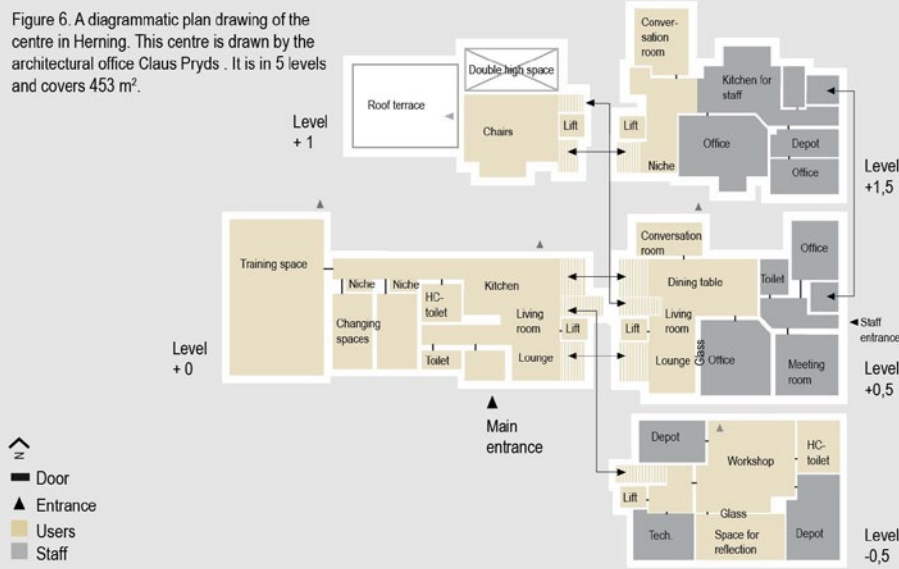




Figure 7. The front façade of the centre in Vejle.



Figure 8. The living room in the centre in Vejle.

Figure 9. A diagrammatic plan drawing of the centre in Vejle. This centre is drawn by the architectural office Arcgency. It is in three plans and covers 1335 m<sup>2</sup> as something unique, the palliative team is in the house as well.

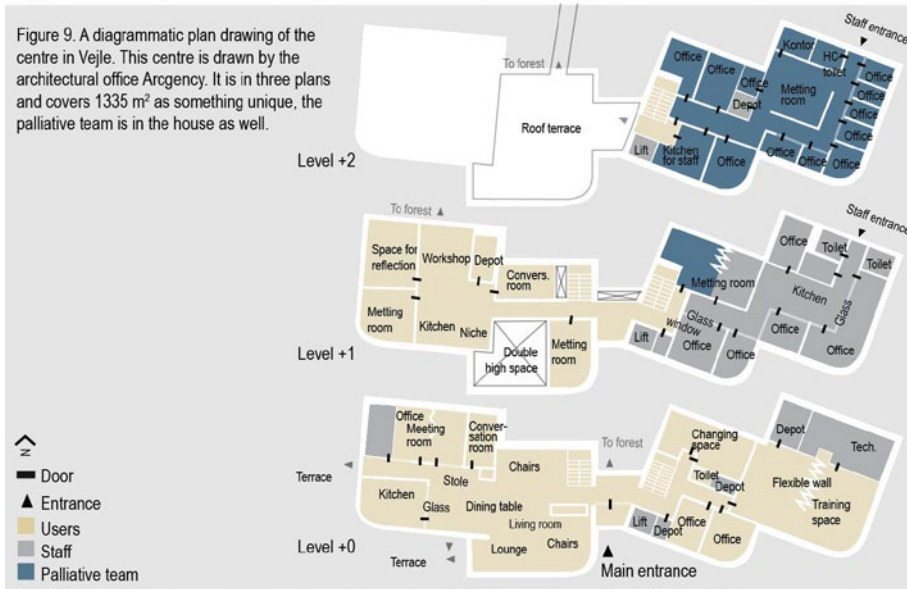


Figure 10. The front façade of the centre in Odense.



Figure 11. The living room in the centre in Odense.

Figure 12. A diagrammatic plan drawing of the centre in Odense. This centre is drawn by the architectural office Wienberg architects. It is in one except for a roof terrace plans and covers 687 m<sup>2</sup>.

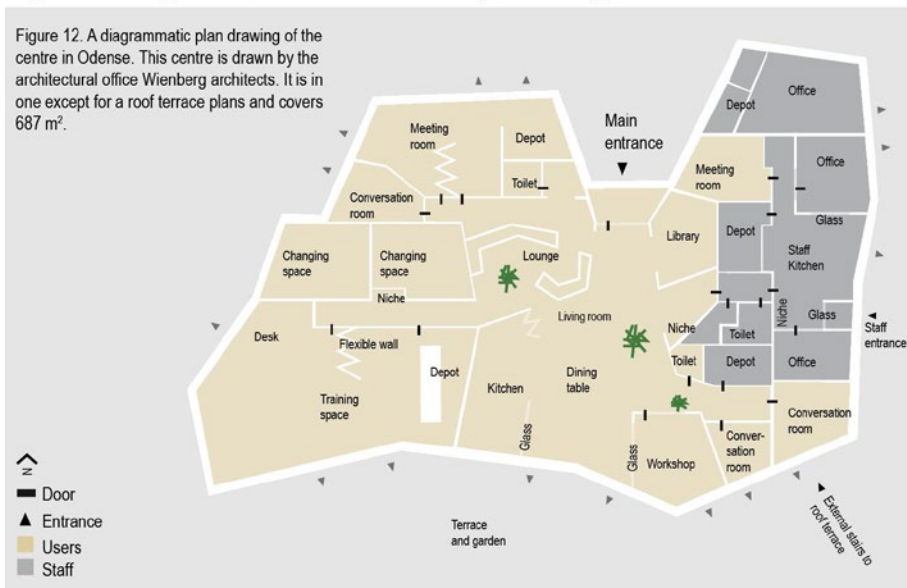






Figure 13. The front façade of the centre in Næstved.



Figure 14. The living room in the centre in Næstved.

Figure 15. A diagrammatic plan drawing of the centre in Næstved. This centre opened in 2013 and was drawn by the architectural office EFFEKT it is in one plan and covers 754 m<sup>2</sup>.

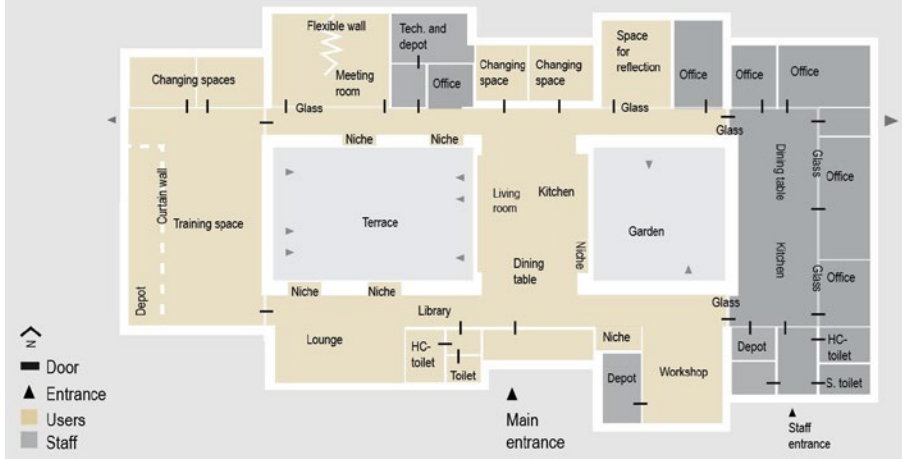
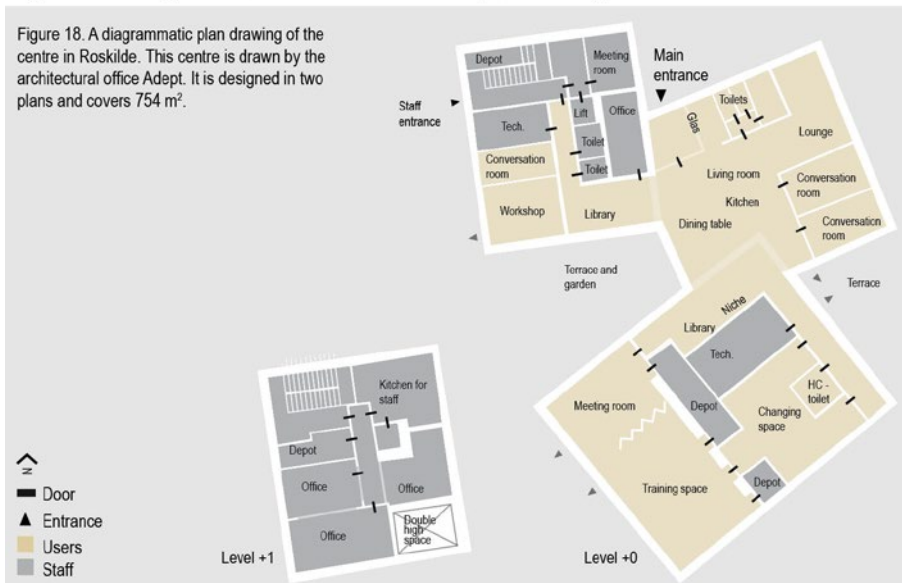


Figure 16. The front façade of the centre in Roskilde.



Figure 17. The living room in the centre in Roskilde.

Figure 18. A diagrammatic plan drawing of the centre in Roskilde. This centre is drawn by the architectural office Adept. It is designed in two plans and covers 754 m<sup>2</sup>.



## Aim

The aim of this paper is to describe and investigate the patients and relatives experiences of the architecture of the six new Danish cancer consultation centres and how they interplay with the supporting activities in the centres.

# Background

The physical surroundings in our build environment affect us as human beings. This is theorized through the field “environmental psychology” as part of psychology developed in the 1960s introduced for the first time by Ittelson during a presentation of a study of factors influencing the design and function of psychiatric facilities (Binnes & Secchiaroli 1995).

That the built environment affects us as human beings is today proved in relation to many aspects, especially within healthcare architecture (Frandsen et. al. 2009; Ulrich et. al. 2008). The light conditions, sound quality, distance between functions, access to nature, privacy and social interaction, the general atmosphere created by the architecture are just some of the parameters in architecture, that can affect the level of stress, quality of sleep, anxiety, wellbeing, comfort but also time of hospitalization, healing, consumption of medicine, the number of errors in treatment, and the general healing of the patients can be affected by the physical surroundings (Frandsen et. al. 2009; Ulrich et. al. 2008).

These effects have been investigated in qualitative and quantitative studies by looking at clinical, economical, functional and experienced satisfaction related outcomes (Nelson et. al. 1996; Frandsen et. al. 2009; Ulrich et. al. 2008). A retro-prospective study describes how patients having a window with a view towards a natural environment had a lower average time of hospitalization compared to patients having windows facing a brick wall (Ulrich 1984). Other studies reveal the users’ experience of their physical environment in an institution and what is valued by both staff and patients (Timmermann et. al. 2014; Gardiner et al., 2011). Other studies conclude that a design of healthcare architecture should be created in a homely expression to make the users feel comfortable in the surroundings (Gardiner et al. 2011).

That the centres are created with a homely expression, have nature in the outdoor areas, an awareness of the social and private needs of the patients and relatives, and a good indoor climate are some of the key elements in the design guidelines (Arkitema 2008).

# Methods

The evaluation behind this paper is based on post occupational evaluation theory, where architecture is evaluated when in use. This is the most common evaluation form of architecture (Preiser et. al. 1988). The architect Vitruvius from the ancient Rome defines architecture as consisting of the three elements “firmitas, utilitas, venustas” (construction, function, and form), which is a common understanding of how architecture is defined (Moffett, Fazio & Wodehouse, 2003). This paper focuses on the functional and aesthetic aspects of the centres.

This paper is based on a phenomenological approach, where the patients and relatives experience is described as it is. Interpretations based on a hermeneutic understanding are however made in the analysis (Fuglsang & Olsen 2007).

The empirical data is collected by observations of the architecture, participant observation and focus group interviews. The architecture, the people using it and their daily lives were observed, to create an understanding of the social, physical environment and the activities, which are present in the centres and are affecting the patients and relatives experience.

An understanding of the basic characteristics of the design of each centre was created by observations based on inspiration from existing approaches to space analysis by the use of “Space analysis” (Bek & Oxvig 1997) and the mapping analysis from Kevin Lynch (Lynch 1960). The near context was mapped by identifying the typologies of the districts, paths, nodes and landmarks by the use of analysis from Kevin Lynch. The focus was on the centres only the nearby surroundings including the hospitals and the main entrance roads. Observations of the architectural design were focusing on form expressions, dimensions, choice of materials and placement of window. The studies of the architectural design focused on the overall building design, the entrance and the living room, however all spaces in each centre were investigated. The researcher’s experience of being in the centres such as the experience of privacy, were not in focus in the analysis, as only the experience of the actual users, were central in this study. These analyses were carried out in all six centres by one member of the research team and documented with field notes and pictures. The observations took place from June until August in 2015 with two days each place.

Participant observations were carried out by one member of the research team as well in three centres in Aalborg, Odense and Næstved. The observations took place April, May, and June in 2015 with two weeks in each place. In this method the researcher switches between observing and participating in the activities within the centres (Szulewicz 2015). Informal semi-structured interviews were carried out with staff, volunteers, patients and relatives during the observations as well. These participant observations were documented in field notes. This contributed to an understanding of the daily routines in the centres but also to data related to the users’ experience of the centres.

The focus group interviews were carried out by two persons participating in the research team. Six focus groups were carried out in total to explore the patients and relatives experience of the architecture, one in each centre. In these interviews, users expressed their impression of the entire house, the outdoor facilities and the distinct rooms and the interior of the centres they



had been presented to when using the house and therefore had opportunity to form an opinion about.

The patients and relatives participating in the focus groups were randomly selected by staff beforehand. A comprising of the average user of the centre is seen in table 1. 40 patients and relatives participated in the interviews. The interviews were carried out in August in 2015.

Based on analysis and interpretations of the entire empiricism, conclusions are drawn across the understanding of the architecture, the flow patterns and users' experiences of the six centres.

Table 1. User characteristics.

Data is from an internal investigation within Kræftens Bekæmpelse, the Danish association for cancer, an investigation made of the users in half of the Danish cancer consultation centres in 2015.

	General user disruption	User disruption in the focus groups
SEX	[%]	[%]
Male	29	40
Female	71	60
AGE	[%]	[%]
0-39 years	22	12,5
40-69 years	62	65
Above 70 years	9	22,5
Unknown	7	0
TYPE OF USER		
Patient or former patient	51,3	62,5
Relative	31,2	25
Relative left behind	17,5	12,5

# Results and analysis

## The architectural design

All centres are placed in an urban area close to the hospital (less than 300 meters). The hospital is often visible from the centres and stands out as a dominating landmark in all contexts, but residential houses are present in the contexts of all centres as well, as the hospitals are often placed in a traffic junction and traffic can be heavy in some of the surrounding areas. Some centres are placed closer to or within a residential neighbourhood, pulling them away from the heavy traffic. As a natural element in especially the residential neighbourhood parks, gardens and green areas are found in the near context of all centres. Whether the public green areas are visible or not from the actual centre differ from site to site.

The architectural design and expression of the centres vary a lot among the centres. The sizes differ from 435 m<sup>2</sup> to 1335 m<sup>2</sup>. Some are created in one level while others in more, and one centre evolves across five levels in total. Five out of six houses are created as new buildings, but one is created in an older renovated villa with an extension (figure 4). The architectural expression varies as well, but there are some similarities. For instance, all centres have an architectural expression, where the entire building is divided in smaller form elements all together creating the architectural form. In some of the centres, this reflects the internal division of the space, but not in all. However, all centres contain the same basic facilities such as an entrance, conversation rooms, a workshop, rooms for groups, toilets, a wardrobe, a training room, offices and a bigger room connecting the other rooms defined as a shared space, a living room, containing different areas such as a lounge, kitchen, dining table, library and smaller niches, areas which are not clearly defined by sharp limits dividing the living room. The number of rooms and the sizes of them differ from centre to centre, but the types of rooms are the same in all houses however in some of the houses a room for conversation is created as a room for reflection (figure 6, 9, 15).

The materials used in the centres vary. But mutual for all centres is the fact, that a number of different materials are used in floorings, walls, integrated furniture, and ceilings. Materials such as concrete, textiles, tiles, plaster, and many different types of wood are used just to mention a couple of the materials. The layout and the amount of interior have some similarities in many of the centres. The living room is often furnished with different types of comfortable, soft looking chairs and sitting arrangements, with a layout similar to what could be created in a home, which is also the case with the layout of the kitchen and often also the furniture's in the conversation rooms and the space for reflection. The office areas, training facilities, workshop, and rooms for groups are often sparingly furnished and the interior and furniture reflect a more neutral design compared to the other rooms.

Nature and green outdoor areas play a role in the design of all the centres. Every house has a garden or an outdoor area in relation to the building and large windows are facing to these areas in many rooms often from the conversation rooms, the training room, and the living room. The outdoor areas contain some kind of sitting area with benches or chairs around a table placed on different kinds of terraces. However, in one centre the outdoor area is dominated by a large forest covering a large area just beside the centre, in others the outdoor areas are designed like a residential garden with a

greenhouse and flowerbeds and in one centre the outdoor area is created like a wild meadow even though the centre is placed in a residential neighbourhood. More pictures are visible in the evaluation report (Falk et. al. 2016).

## The daily routines – flow patterns

The people in the centres, in this case staff, volunteers, patients and relatives behave depending on their errand and task in the centre and they each use different parts of the centres. The central placement of the living room makes it a space everyone passes through and it is therefore the busiest spaces of the centres.

When a patient or relative arrives for the first time, they are usually received by a member of staff or a volunteer worker in the living room. There is no actual reception in the centres but a volunteer often stays in the kitchen or by the dining table ready to receive new patients and relatives. The participant-observation showed that if a staff member or volunteer did not approach a new arrival immediately, some sat down and waited, others moved slowly around, like they were looking for a staff member and did not know where to go.

Patients and relatives having an appointment to join an activity or a conversation stay in the living room as well. They use it as a waiting area, before and after joining a group activity or before a conversation. Some of these users have been joining an activity a number of times. They are aware of the unmentioned rules and are familiar with being in the centre. They walk around, sit where they like and take a cup of coffee without asking anyone. Some patients and relatives use the centre as a waiting area, when having an appointment at the hospital as well.

While being in the living room some patients and relatives start chatting even though they do not know each other. This often happens by the dining table or the lounge area. Others just walk through the living room and go straight to the room, where they have an appointment. Most, however, stay in the living room until the time of the activity is approaching, and some wait for a staff member to guide them to a room.

When patients and relatives join an activity, they primarily stay in one specific room relating to the activity they join. Conversations go on in the conversation rooms, conversation groups in the group rooms and drawing classes in the workshop. However, those joining training activities in some cases use other areas as well such as the outdoor facilities, and they often meet for coffee by the dining table in the living room. In the evening when only a few activities go on in the centre the living room is sometimes used in activities where patients and relatives make dinner in relation to certain group sessions.

Otherwise patients and relatives only move in the areas of the building they are familiar with or have been invited into. They do not go into the staffs' areas, depots or rooms they have not had an errand in before.

As mentioned earlier a volunteer often stays in the living room when the centre is open during the daytime. Staff members often just cross the living room when going to a minor room to join an activity or when meeting with patients and relatives. Most of the time, they stay in the office areas or in the rooms they facilitate activities in.

## Reactions by patients and relatives

The patients and relatives participating in the evaluation have many opinions to give concerning the centres, and they reflect upon the location, the architectural expression and the interior. Nearly all of them had an opinion to give towards the site where the centres are situated and the general external and internal expression of the centres. Many state that it is very important, some even used words as “*brilliant*” or “*perfect*”, that the centres are placed right next to the hospital making them easy to find and access. A couple of patients and relatives describes that the location right beside the hospital, was essential for their first visit. Others describe, that when the centres have a visible location and a notable expression, they were aware of it even before they needed it.

Many patients and relatives comment on the aesthetical expression the centres and the emotional state it put them in. One feels curious, another comfortable when looking at one of the centres and others experience a centre as friendly, nice, and light. The patients and relatives participating in the focus groups sometimes disagree and have different experiences. They often disagree about their experience of the materials in the centres, because a material reminds them of things they either like or dislike. It seems that some dislike a material when they find it unfamiliar or when it reminds them of a clinical institution. Some experience a contrast between the external and internal expression, this is especially the case when they do not like the external expression, but like the internal expression.

All patients and relatives giving their opinion had experienced being in the living room. Nearly everyone had positive opinions concerning their experience of the living room some describe it as the “*heart of the centre*”, others note that they experience it as warm, open, friendly, kind and welcoming. Many describe that atmosphere in the shared room can be related to a homely environment by the choice of furniture’s, but also the facilities such as the kitchen and the lounge. But also double high and asymmetric spaces, windows with views to nature, integrated bookcases, different sitting arrangements with different degrees of privacy, and good acoustic conditions are mentioned as some of the appreciated elements in these spaces, which make it comfortable to stay there. Some patients and relatives highlight and value that the room does not look like an institution because of the choice of materials, furniture and the different spaces such as a kitchen and a lounge area.

Many of the patients and relatives have not been in or used all the available rooms, only the ones they had an errand in. For some their experience of the living room equals their experience of the entire centre, and it can be difficult for them to describe their experience of the different individual rooms and what their experience relate to. However, all patients and relatives attending the focus groups have had an errand in one of the smaller rooms. Many have visited either a conversation room or the training facilities, and maybe one or two of the other rooms. All of them have positive responses to the conversation rooms. They find them cosy and homely. They highlight it as a positive element, that you are seated towards the staff member in soft comfortable chairs, without a desk in front. They enjoy the fact that they experience feeling safe and private and relates it to the fact that the spaces are small and that the windows do not exhibit you towards public space but on the other hand face areas with nature elements that they enjoy looking at. One even describes, that she “*feel like opening up*” when she is in the space.

In many of the spaces, the patients and relatives have joined an activity. Their comments tend to reflect the functional aspects of the spaces. Regard-

ing the training facilities, some say that they fulfil their purpose others comment, that their rooms were too small, too big or that there was not enough space for group activities. But some of those who have joined the training activities reflect upon the views from the training facilities and tell that they enjoy looking out towards the green outdoor areas. Some also reflect upon lacking interior or an experience of a messy expression.

# Discussion

## Staff and Volunteers

When describing the physical environment some tend to mix their experience of the space with their experience of the people they have met.

*“I don’t think you can be anything else than extremely surprised by a building like this. It is impressive (...) at the same time you met these extremely lovely people. It was so extremely impressive coming here.”* one explains (Falk et. al. 2016, p. 84).

When the patients and relatives were asked to describe the outdoor areas, the architecture and the interior, many also explain how they had been received by staff or volunteers or how they have experienced the company of others in the centres, making it clear that the presence of other people in the centres affects their overall experience of the centres.

Others divide their experience into two, but there were no examples of patients and relatives having a bad experience of the people they have met in a space they enjoyed being in. The experiences seem to be linked.

The patients and relatives experience or interaction with staff and volunteers affected the way they acted in the centres as well. When they joined the centres for the first times they needed guidance to learn the unmentioned rules of how to behave and use the centres. As an example patients and relatives who had joined the centres multiple times, knew that they were allowed to take a cup of coffee and sit where they like without asking, and they knew that the staff or volunteers would approach them in the living room even though there is no sign saying “wait here” or a bell to ring. The volunteers and the staff are also the key to the way the centres are used, during the focus groups it became clear, that not all spaces were known the patients and relatives, simply because they were not made aware of the by the staff or volunteers, though the spaces are there for their use whenever they like. Some are as an example unaware of the outdoor areas and the workshops, but all so of the fact that they may use these areas.

## Interaction between the patients and relatives

The interaction between patients and relatives is also affected by the design of both the architecture and the interior. The living room is, as mentioned earlier, a room where many different users can meet each other, making it a room where interaction naturally occurs and a room where the design plays a role.

The open design of the living room, where minor areas are marked but not clearly limited, means that people staying in one part of the room easily can see, hear and interact with others in the room. Many patients and relatives participating in the evaluation have experienced seeing others wait in the room or seen new patients and relatives arrive. Most find it cosy or comfortable to experience and interact with other in the room. They tend to start chatting in the lounge or dining areas, especially when they are designed so there is one big lounge area and they do not sit too close to one another. If there are many choices, they tend to choose sitting areas further away from each other, and interaction does not occur.

The floating and open space can on the other hand also create forced and unwanted interaction. Where some patients and relatives have felt that the living room did not meet their needs for privacy. Some had a hard time dealing with other patients and relatives while they were dealing with heavy emotions in the space. Others are concerned about the feelings of new fragile patients and relatives approaching the centres for the first time and being exposed to or overhearing difficult conversations. Some describe, that this can occur when large groups of people, who know each other, stay by the dining table. They feel that they can dominate the room to an extent where others do not feel welcome, especially when a new patient or relative is approaching. This situation often seems to occur in centres, where the dining table is placed just across the entrance door. It does not seem to occur in centres where the living room is big enough to create other areas, where new users can approach peacefully, and if the dining area is placed away from the entrance area. When the patients and relatives discussed these situations in the focus groups it was clear that not all had the same experience of these situations, some felt that when seeing a sad person in the living room they could relate the situation, because they felt they knew why the person was sad, and because they were used to being sad because of the sickness as well.

The experiences of the interactions are thereby not the same for everyone in the living room. Where some are comfortable among the presences of others, some patients and relatives can experience situations where they are uncomfortable in the same situations.

The design of the smaller spaces affects interactions as well. Especially the feeling of being in private is important in many of the spaces. As an example, the patients and relatives enjoy that the conversation rooms are designed as small spaces, where you can close the door and feel private it fits their needs in this situation. This is also mentioned in relation to rooms for groups. Some of these rooms have glass walls towards the living room, and if not permanently covered by a defuse film these walls are often covered with a curtain, whenever they are in use, to make them fulfil their purpose.

# Conclusion

The patients and relatives experience of the architecture of the six new cancer consultations centres in Denmark is covered by participant observation and by focus group interviews with 40 users (patients and relatives), who have been using one of the centres.

The location, the architectural and the interior design of the centres affects the patients and relatives experience. They have opinions of what affect them and what is important for their positive response to their design. Some focus on the feelings they have when being in the centres, others describe how their experience and feelings are related to specific elements within the centres or the design of space.

The locations beside the hospitals make the centres easy accessible for the patients and relatives and it contributes to their awareness of the centres. They find that the design of the centres stands out as something different than a normal institution. The fact that the centres have a different design also contributes to their awareness of the specific centre they have used. Many patients and relatives have an opinion of the aesthetical expression of the centres. Most find, that they appear light, welcoming, and have a homely vibe in especially in the internal layout of the architecture and the interior design.

The architectural and the interior design in especially the living room affect the patients and relatives feeling of being in a safe, cosy, and comfortable environment. The living room creates both private and social environment by optional areas that float together within the space. They link the expression to a homely environment, both because of the functions in the living room (kitchen and lounge), but also because of the design of and choice of interior (different types of comfortable furniture). This design makes the patients and relatives enjoy being in the living room.

The experiences of other people in the centres are important to the patients and relatives experience of the architecture. The behaviour of staff and volunteers affects the patients and relatives experience and use of the centres. They are the key to their knowledge of the unmentioned rules in the centres and they impact which space the patients and relatives are aware of. The physical design affects the interaction as well, and in the living room some settings can help interaction. In specific situations, some patients and relatives can, however also feel that their or others needs for privacy or sensitivity are not met, due to a specific situations and centres with many people in the room.

The design of the surroundings, the architecture, and interior contribute to the patients and relatives joy of being in the centres, and thereby contributes to the support they receive during activities and consultations in the centres. Especially the conversation rooms fit the interplay with the supporting activities, by being experienced as private, comfortable and sheltered spaces. Unwanted situations, that does not accommodate all patients and relatives' needs, can occur in the living room when users experience of the presence and behaviour of others as unpleasant.



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# Theoretical frameworks in Healthcare Built Environment research – a scoping review

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## Abstract

*The potential of the built environment to mediate effects on patient and care-giver physical, cognitive and social health continues to be advocated. Evidence indicates that well-designed physical settings play an important role in making healthcare facilities safer and more healing for patients, and better working places for staff. Collaboration between researchers from varied disciplines is now adding to our understanding of the range of impacts on patient health and well-being. For instance, health architecture and interior designers are involving users of healthcare built environments in the design process using inclusive design or patient-centred care frameworks. Neuroscience researchers are exploring relationships between the environment and recovery from brain injury, often using a model of enriched environments. An overview of the range of theoretical frameworks used in empirical research to test built environment attributes is now warranted. In this paper, we present a mapping of the field showing the use of theories in built environment research. This would enable better selection of theoretical frameworks in order to evaluate the effect of specific design solutions on patient and care-giver health. Today, there are no comprehensive summaries of theories and conceptual frameworks applied in studies of healthcare architecture that could serve as a guide to future research. The aim of this scop-*

*ing review was to (i) identify theories and frameworks used in research of the physical environment in health care, (ii) describe their core constructs, assumptions, scientific utility, (iii) assess their applicability and feasibility for use in research. The basic principles of Arksey and O'Malley's model of scoping review design were used to identify the theories and frameworks. 15 theories/frameworks were included and described in terms of general characteristics (purpose, country and year of development, discipline), core construct and applicability and feasibility.*

*Keywords: theoretical frameworks, evidence-based design, patient health, clinical safety, scoping review*

# Introduction

This study presents the first step in a review of theories used in research of the healthcare environment and its impact on individuals and processes. This first step involves a summary and synthesis of theoretical models and frameworks found in literature and their operational concepts and application areas. This paper is part of a larger study involving inter-disciplinary collaborators investigating the application and utility of theoretical models and frameworks in research of healthcare built environment and its influence on health and well-being.

## Definition of healthcare built environment

The physical environment (or built environment) of health and healthcare facilities has been described as a holistic place of healing where physical domains of the built environment and interactions between people within that environment intersect (van Hoof and Verkerk, 2013). Specifically, a healthcare physical environment consists of the permanent features of configuration of patient rooms (and private living areas) and communal areas (for dining or activity, and for staff communication). The environment also incorporates the non-permanent features of lighting options, temperature control, noise control and amount of daylight exposure. Finally, access to the outdoors and nature elements is often argued to be important for health and well-being for people located in that environment.

The people exposed to these healthcare physical environments are patients and families accommodated in these health facilities on either a short-term basis e.g. an acute hospital admission or a long-term basis e.g. residential care settings. In addition, it is argued that the staff working in these varied types of health facility can be influenced by the built environment (Harris, Shepley, White, Kolberg, & Harrell, 2006; Okcu, Ryherd, Zimring, & Samuels, 2011; Shepley, Gerbi, Watson, Imgrund, & Sagha-Zadeh, 2012). Several researchers have reported the importance of the built environment in contributing to quality patient care (Ulrich, Berry, Quan, & Turner Parish, 2010; Ulrich et al., 2008), in reduction of anxiety (Laursen, Danielsen, & Rosenberg, 2014), to increased satisfaction (Andrade, Lima, Pereira, Fornara, & Bonaiuto, 2013; Douglas & Douglas, 2005) and to more social connection (Persson & Maatta, 2012). Many different theoretical frameworks have been used in the research in architectural, environmental psychology and neuroscience research studies.

This study intends to delineate the wide range and scope of theoretical conceptual frameworks in use by researchers from diverse disciplines when examining effects of the built environment on patients and staff.

# Background

Evidence-based design (EBD) or evidence-based architecture is a growing research field in health care (Hamilton, 2003). It has been championed as an important framework for basing decisions of the built environment on information from credible evidence (Brown & Ecoff, 2011; Diaz Moore & Geboy, 2010; Pati, 2011; Viets, 2009). There is increasing research showing that the built environment can influence the health, well-being and behaviours of people located within that environment (Choi & Bosch, 2013; Gharaveis, Shepley, & Gaines, 2016; Gray, Kesten, Hurst, Duffy Day, & Anderk, 2012; Healy, Manganelli, Rosopa, & Brooks, 2015; Hume & Ahtamad, 2013; Larsen, Larsen, & Birkelund, 2014; Raanaas, Patil, & Hartig, 2011; van Hoof, Aarts, Rense, & Schoutens, 2009). However, advancement of credible evidence also requires the conduct of rigorous studies of the influence of design features on people, requiring the application of theory (Diaz Moore & Geboy, 2010). Developing testable hypotheses based on theory enhances our understanding of the constructs under study and their relationships, and allows for interpretation of study results (Becker, Bonaiuto, Bilotta, & Bonnes, 2011). The value of theory is rarely questioned, but theory application and the degree to which theory is integrated into research is varied (Rashid, 2013). In addition, there is conflicting guidance in the literature to date regarding what theoretical frameworks are most applicable to which health care settings and in what types of research studies. Until today, there has been no summary and synthesis of the theoretical models and frameworks used in research of the physical environment in health care. Thus, the present paper can begin to optimize theory application in healthcare built environment research.

## The health care built environment and quality of care

Today, the built environment is viewed as an essential factor for the achievement of high quality in health care (Barach & Johnson, 2006; Berry et al., 2004; W. Gesler, Bell, Curtis, Hubbard, & Francis, 2004). Quality patient care is frequently implicated as a key driver for improvements in health. The goal of quality patient care is often viewed as timely access to necessary investigations and therapies while in hospital. However, more recently following examples of hospital medical errors and patient safety worldwide, the focus of quality care has shifted back to the built environment in which patients and staff are located (Barach & Johnson, 2006; Institute of Medicine, 2001). The environment is suggested to be important for optimising the safety of clinical processes (van de Glind, de Roode, & Goossensen, 2007; Voor in 't holt, 2016), social connections with others (Persson & Maatta, 2012; Verdeber & Todd, 2012) and the reduction of exposure to stressful stimuli (Gray et al., 2012; Mackrill, Cain, & Jennings, 2013; Okcu et al., 2011; Ulrich, 1991). Thus, today, the built environment of healthcare is viewed more than just a vehicle to contain the procedures and practices of clinical care of people. It is an active factor within the definition of quality in patient care.

Nowadays, research into the relationship between built environment and human behaviour resulting in quality care outcomes has resulted in the use of EBD to describe the range and strength of evidential support. EBD involves combining evidence gained from experimental research with experi-

ential knowledge and reasoning to make decisions about the design to support the patient's path to health (Diaz Moore & Geboy, 2010). It is an overall umbrella term inclusive of any step that might bridge the gap between what we know and how we use that knowledge in the planning and the design process of built environments of health (Brown & Ecoff, 2011). In a seminal review of studies that evaluated the physical environment (Ulrich et al., 2008), categorized and summarized the range of attributes that have been shown to impact on patients and staff in a healthcare setting. However, this review did not explicitly highlight underpinning theories to guide selection of the included studies. Systematic reviews have extended our knowledge of the strength of some of this evidence (Drahota A et al., 2012; Huisman, Morales, van Hoof, & Kort, 2012; Marquardt, Bueter, & Motzek, 2014), often applying a critical approach to the systematic review process of study identification and selection in health design research. Becker et al. (2011) have argued that the absence of theories and predictive modelling from studies is a research gap.

## The healthcare built environment and theories

Theoretical frameworks according to the Oxford Dictionary are "... basic conceptual structure (s) underlying a system or study..", and theoretical models are "... descriptions "...used to understand the way in which a particular system or process works." It is very common for scientific health research to be involved in using research studies to develop or test such theoretical models. In this way knowledge is gained about how a process such as the effect of the built environment in health facilities might affect people exposed to that environment. Once understanding is advanced about how the built environment could affect people in that environment such as staff, patients and families, then studies can be rigorously designed to determine the efficacy of one built environment type over another, similar to the conduct of controlled study designs in evidence-based medicine. A number of theories have been proposed in empirical and non-empirical studies, that now require investigation in order to summaries the range and frequency of these theories used by researchers in health sciences, architecture and interior design, and environmental and social psychology disciplines.

Since the 1950's onwards, many theoretical frameworks and assumptions have been suggested to explain the effects of the physical environment on people exposed to that environment. It has been well documented by researchers in childhood development that the physical environment can influence behaviour, for example using twin studies whereby identical twins are reared in non-shared physical environments and comparison is made between twins in personality trait testing (Bonnes & Secchiarioli, 1995). As environmental psychology developed as a new field it became clear that the behaviour of people in urban environments could be influenced by the arrangement of physical features in neighbourhood environments e.g. location of parks and amenities on resident satisfaction with living there (Lawton, Windley, & Byerts, 1982). Furthermore in environmental psychology, frameworks such as Lawton's "Person-Environment Fit" theory and ecological theories (Becker et al., 2011) were advocated to explain how the built environment can impact on health behaviour in older people. These proposed theories were important as researchers sought ways to improve the health outcomes of older people living with dementia or living in residential settings. For instance, Lawton (1982) and others have argued that an older person's ability to live in a given environment is related to their competence to cope with the stressors contained within that environment. There continues to be many theoretical frameworks used in built environment research purported



to underpin observed physical, physiological and psychological effects on people.

In nursing, the built environment has been one of the core concepts (Fawcett, 2005), with Florence Nightingale in the 19th century emphasising the importance of the environment for people's health and well-being (Zborowsky, 2014). For instance, aspects in the built environment such as adequate ventilation and daylight were regarded to support recovery processes among patients (1980). In more recent years, the built environment has been viewed as an essential factor for "person-centred care" as it is suggested to have the potential to facilitate or restrict care processes that consider people's personal resources, needs and preferences (McCormack and McCance, 2006).

In neuroscience and early environmental psychology, animal behaviour has been studied to discover how physical environment factors such as amount of space and availability of food resources in a given environment can influence where animals move to and interact with each other in that environment. For instance (Hall, 1966) used "proxemics" to describe the effects of the animal crowding on animal behaviour e.g. in the behaviour of rats and sika deer. This concept of patient density in a defined hospital or residential space (patient density) has in recent years been used to explain somewhat the preference patients have for privacy in healthcare contexts (McLaughlin, Olson, & White, 2008). More recently neuroscientists have used 'environmental enrichment' theory in research studies, comparing the effect of one physical environment with enhanced opportunities for physical, cognitive and social activity on animal and human populations, to a standard housing environment (Johanssen & Belichenko, 2002; Schloesser, Lehmann, Martinowich, Manji, & Herkenham, 2010). Further, researchers have been able to test the efficacy of "environmental enrichment" in randomized (Lambert et al., 2016) or non-randomized comparative trials (Janssen et al., 2014).

In research of the physical environment and healthcare for older people, Lawton and Nahemow's ecological theory (1973) has often been used to explore the inter-relationships between people and their environments. According to this theory, the older person is defined as having a set of competencies, and the environment is defined in terms of demands the older person is subjected to. A person's overall competence involves their individual competence in health, function, and motor and sensory skills, while environmental demands incorporate both the physical and the social environment. Positive outcomes can be achieved when there is an optimal "fit" between personal competencies and environmental demands, whereas a mismatch can result in negative outcomes (Lawton and Simon 1967, Lawton and Nahemow 1973).

In studies of the built environment and rehabilitation, the International Classification of Functioning, Disability and Health (ICF) framework (Schneidert, Hurst, Miller, & Ustun, 2003) has started to be used. According to ICF an individual's health is the result of the interaction between the individual's functioning and contextual factors such as the design of the person's environment, which can facilitate or create barriers to the individual's activity and participation (WHO, 2015). The model classifies factors that forms the context of a person's life and affects the person's functional status. The factors in the context may have a facilitating or hindering impact in terms of the different elements of the physical environment. An environment with barriers or without facilitators makes it more the person more difficult for the individual to carry out various activities. Society may hinder a person's performance of activities by either creating barriers, such as in the form of inaccessible buildings.

The importance of EBD is still emerging, and as such requires a greater awareness now of how theory and its application to healthcare built environment research can support this development further. Thus, we initiated a descriptive scoping review of theories used in research on healthcare built environments to illustrate how these theories have been applied in different disciplines. This study can provide a basis to discuss and decide on theory application in healthcare built environment research.

## Purpose

The purpose of this paper was to (1) identify theories and frameworks used in healthcare built environment research (Step 1 of our scoping review) and (2) facilitate understanding of their application by reviewing how these theories have been applied in healthcare built environment research (Step 1 and 2). The specific scoping review question was: "What is the extent, range, and nature of theories that are presently being applied in research that investigates healthcare architecture and its influences on people's health and well-being?"

## Method

### Research Design

A scoping review process was used to guide this study (Arksey & O'Malley, 2005) in order to map the field. The steps of this method are: identifying the research question; identifying relevant studies; study selection; charting the data; collating, summarizing, and reporting the results. In contrast to a systematic review, which assesses quality as a basis for study inclusion, a scoping review summarizes all of the literature within a defined set, regardless of quality, in order to examine the range of studies that exist (Arksey & O'Malley, 2005).

For the first step of our review process, we searched the literature to capture search terms commonly associated with all possible theoretical frameworks used in health architectural research in an iterative process. In addition, our aim secondary objective is to conduct a second stage review of the literature using a systematic approach of study selection in order to summarize and synthesize the scientific utility of the theoretical frameworks in health architecture research.

Three reviewers (MS, ME, SN) searched a range of databases including OVID (Medline), ProQuest, PsycINFO, Avery, CINAHL, Web of Science, and Scopus during April 2015- August 2016, from database inception to August 2016. The search strategy was determined iteratively by applying keywords and search terms for theoretical frameworks used by published researchers in the field, for instance "Enriched Environments " and "Therapeutic Landscapes". Synonyms for these terms were also used such as "Ulrich's Theory of Supportive Design" versus "Stress-Reduction Theory". These concept search terms were then combined with all synonyms for the "physical environment" concept term using Boolean operators i.e. "health facilities environment", "physical health care environment\*", "health care space\*", "health care setting\*", "health care architecture\*", "health care building\*", "health care design\*", "evidence-based design\*", "built environment\*", "hospital design\*", "hospital construction\*", "hospital environment\*".

All adult health environments were considered including residential or long-term care, stroke rehabilitation, acute hospital, mental health and cancer care. In addition key authors (Ulrich, Nanda, Shepley, Hannon, Gesler, Elf)

were searched and key journals hand-searched (HERD) to locate additional material.

Three reviewers (MS, ME, SN) identified relevant theories from studies during an iterative process following the first step. The studies relating to these theories were then saved to a shared online table (Table 1). In addition, interdisciplinary consensus opinion was used to ensure relevance of studies selected. All retrieved articles were saved to a shared EndNote library.

# Results

This first step in our scoping review showed that fifteen theoretical frameworks could be identified that have been used to explain the effects of the built environment on people exposed to those environments. It can be seen (Table 1) that the theories used have extended from the 1960's to 2013, with an additional new framework described in 2013 (van Hoof & Verkerk, 2013). Ten theories have been described in environmental psychology or psychology e.g. Attention Restoration Theory (Kaplan, 1995), one theory has originated in health geography i.e. "Therapeutic Landscapes" (W. M. Gesler, 2003), one was initially described in neuroscience (Johanssen & Belichenko, 2002), one has arisen from work conducted by the W.H.O in the definition and determinants of population health (World Health Organisation (WHO), 2001), and two theories have been proposed for use in architecture i.e.. "Inclusive or Universal Design" (Heylighen & Bianchin, 2013) and the "Inclusive and Integrated Health Facility Design Model" (van Hoof & Verkerk, 2013). These theories have been adapted for use in the reporting of effects of the healthcare built environment as can be seen in Table 1. In addition we have shown a purposive sampling of studies in which researchers have explicitly described using their named theory of choice during the conduct and reporting of their study. From this first step of our scoping review it can be seen that the theories most frequently used in empirical research of the built environment and human behaviour or health outcomes are: "patient-centred care", "stress-reduction theory" and "attention-restoration theory". Most theories have been applied to acute hospital or dementia-care settings. One theory has been adapted from neuro-scientific study of animal models of brain injury (Johanssen & Belichenko, 2002).

Multiple theories can therefore be seen in use across the health architecture field. It can also be seen that some researchers cite more than one theory to explain their results or to test their hypotheses e.g. use of "theory of visual affordances" connected to "family- or patient-centred care" (Choi & Bosch, 2013). Combination of theories in this way during the conduct of scientific research limits the opportunity to discover the importance of independent variables (the built environment intervention). When this happens it is then unclear what built environmental feature or factor or combination of factors may have contributed to the effect observed (the dependent variable) during the conduct and reporting of the study.

Our findings also show that psychological dependent variables or measures are used most often to report the outcome of use of a given built environment feature i.e. 12/15 of the theories in this review e.g. self-report or interview based (Antonovsky, 1993). It seems from this brief overview that the built environment is considered to exert an effect on people via cognitive-evaluative or affective mechanisms. The remaining theories use observational or objective measures of people's responses e.g. use of heart rate recording (Ulrich, 1991), or behavioural mapping of activity (Janssen et al., 2010), or brain imaging (Johanssen & Belichenko, 2002). It therefore appears unclear if physiological, psychological or psychological measures can all be linked to theories of built environment. It remains uncertain what outcome measures are best suited to what theories. It remains problematic how to combine and synthesize the results of studies using disparate measures in order to establish summary efficacy measures of the responses' of people.

## Conclusion

Following our first step in our scoping review, it is clear that there are multiple theoretical frameworks in use across a wide range of disciplines researching the effects of health architecture. Following the conclusion of the first stage, we are now preparing to conduct the second step of our scoping review identify a systematic approach of reviewing the literature with a refined search strategy where we combine 3 concepts (“physical healthcare environment and synonyms” AND “theoretical frameworks and synonyms” AND “key framework of interest”). This would allow us to more systematically identify articles that have used particular theoretical frameworks explicitly in experimental and non-experimental studies i.e. to develop or extend a theory or to test a theory during the conduct of that study.

In the next stage of this review therefore, we aim to comprehensively tabulate these and extract the key core theoretical and operational constructs. In addition, general characteristics of the studies that describe the identified theoretical frameworks (purpose, country and year of development, discipline) will be extracted. We propose developing guidance on how to identify more rigorously what theories have shown more scientific utility in framing research questions about how the healthcare built environment impacts on human health and behavior.

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Name of Theory	Year developed	Developer's Discipline	Healthcare Built Environment Context studied	Theoretical Construct	Operational Construct
1. Hall's Theory of Proxemics	1966	Environmental Psychology  Hall, E. T. (1966). <i>The Hidden Dimension</i> . Garden City, NY: Doubleday & Co. Inc.	Rehabilitation care.	Personal space & territoriality	Unclear how measured.
2. Evolutionary: Prospect-Refuge Theory	1975	Psychology  Appleton, J., 1975. <i>The Experience of Place</i> . Wiley, London. Appleton, J. (1996). <i>The experience of landscape</i> . Chichester. United Kingdom: Wiley.	Healing garden spaces Simulated environments.	Prospect (clear field of vision) and Refuge (place to hide from predators) has emerged from evolutionary theories.	Subjective preferences; Ratings of restoration, fear, danger.
3. Place Theory	1977	Environmental Psychology  Canter, D. (1977). <i>The psychology of place</i> . London: Architectural Press.  Bonnes, M., & Secchiarioli, G. (1995). <i>Environmental psychology. A psycho-social introduction</i> . London: Sage	Environmental Psychology.	Place attachment.	Unclear how measured.
4. Visual Affordances Theory	1979	Psychology  Gibson, J. J. (1979). <i>The ecological approach to visual perception</i> . Boston: Houghton-Mifflin.	Acute hospitals.	Perception of visual properties of objects in an environment, integrated with previous experience with that object and the meaning ascribed to that object.	Subjective responses.
5. Ecological: Person-Environment Fit Theory	1982	Environmental Psychology Lawton, M.P. (1982) <i>Competence, Environmental Press and Adaptation of Older People</i> . New York: Springer Publishing Co., Inc.	Dementia care; Residential settings.	Describes person attributes e.g. biological deficits, personality, personal qualities, AND environmental press (configuration of urban environment; access to social supports).	Outcome reflects measure of the individual's coping / adaptation.
6. Salutogenics	1987	Psychology  Antonovsky, A. (1987). <i>Unravelling the mystery of health: how people manage stress and stay well</i> (1st ed.). San Francisco: Jossey-Bass.	Acute hospitals; Mental health care; Cancer care; Dementia care.	Sense of Coherence: comprehensibility, manageability & meaningfulness concepts. Bio-psychosocial considerations important to protect against illness development.	Subjective cognitive responses of coping.

7. Evolutionary Theory: The Biophilia Hypothesis	1980-1990	Psychology	Acute hospitals.	Evolutionary basis for humans' natural affinity for nature, "savannah-type" landscapes related to security, potential for food – this could explain affinity for certain green or natural landscapes.	Staff and patient subjective preferences.
		Kellert, S. R. (1993). <i>The Biological Basis for Human Values of Nature</i> . In S. R. Kellert & E. O. Wilson (Eds.), <i>The Biophilia Hypothesis</i> : Island Press.			
8. Stress-Reduction Theory or Ulrich's Theory of Supportive Design	1991	Psychology / Architecture	Acute hospitals- surgical; ambulatory clinics; Mental health care.	Stress reduction; Positive distractors using design attributes e.g. lighting / acoustic / room type.	Objective or observational, physiological and psychological measures/attitudes. Reported hospital performance measures e.g. falls or infection rates.
		Ulrich, R. S. (1991). <i>Effects of Healthcare Environmental Design on Medical Outcomes</i> . Paper presented at the International Academy for Design & Health.			
9. Attention-Restoration Theory	1995	Environmental Psychology	Mental health care	Fatigue/ fragility of attention during voluntary tasks (directed attention); Periods of involuntary attention or "getting away", with "Extent", and "Fascination" elements important for restoration.	Subjective responses of mood and memory.
		Kaplan, S. (1995). <i>The restorative benefits of nature: Toward an integrative framework</i> . <i>Journal of Environmental Psychology</i> , 15(3), 169-182.			
10. Patient-Centered Care or Person-Centred care	1995-2006	Nursing/ Psychology	Acute hospitals, medical-surgical care.	Humanistic and holistic care of patient with patient engagement and partnership in care process.	Observational measure coding of doctor–patient verbal encounters.
		Stewart, M., Brown, J., Weston, W., McWhinney, I., McWilliam, C., & Freeman, T. (1995a). <i>Patient-centred medicine: transforming the clinical method</i> . London: Sage; Mead, N., & Bower, P. (2000). <i>Patient-centredness: a conceptual framework and review of the empirical literature</i> . <i>Social Science &amp; Medicine</i> , 51, 1087-1110; McCormack, B., & McCance, T. V. (2006). <i>Development of a framework for person-centred nursing</i> . <i>J Adv Nurs</i> , 56(5), 472-479.			
11. Enriched Environments	2002	Neuroscience- animal & human study.	Stroke rehabilitation.	Provision of augmented opportunities for voluntary physical, social and cognitive exploration	Objective measures i.e. brain imaging measures of neuronal precursor cells and trophic signals in the brain; behavioural mapping of animal & human populations.
		Johanssen, B. B., & Belichenko, P.			

		V. (2002). <i>Neuronal Plasticity and Dendritic Spines: Effect of Environmental Enrichment on Intact and Post-ischemic Rat Brain. Journal of Cerebral Blood Flow &amp; Metabolism</i> .22, 89.		and activity in physical environments e.g. running wheels, toys, other animals, novelty of objects in environment, colourful objects, natural versus artificial objects, larger cages.	
12. International Classification of Functioning, Disease & Health	2002	WHO- individual and population health  World Health Organisation (WHO). (2001). <i>International Classification of Functioning, Disability and Health</i> Geneva, Switzerland: WHO.	All health contexts- some diseases have quality outcomes mapped onto the 3 dimensions e.g. Multiple Sclerosis with measures of bodily structure, activities and social participation.	Health defined in terms of bodily structure, functional activities and social participation.	Environment construct according to model is considered a "contextual "" component.
13. Therapeutic Landscapes	2003	Health Geography/ Environmental Psychology/ Psychology  Gesler, W. M. (2003). <i>Healing Places</i> . U.S.A.: Rowman & Littlefield Publishers Inc.	Acute hospital care.	Aesthetics and symbolism recognized as contributing to a person's healing capacity; Social relationships between staff and patients important.	Subjective responses.
14. Inclusive Design or Universal Design	2012	Architecture  Design Council. (2009). Inclusive design education resource. <a href="http://www.design-council.info/inclusivedesignresource">http://www.design-council.info/inclusivedesignresource</a>  Preiser, W., Ostroff, E., (2001) <i>Universal Design Handbook</i> . McGraw Hill, New York, USA.	Cancer care.	Participatory design between needs / goals of designer and needs / goals of the user e.g. hospital planner, patients. Incorporates diversity.	Subjective ratings of stakeholders i.e. designers and users.
15. The Inclusive and Integrated Health Facilities Design model	2013	Architecture / Technology  van Hoof, J., & Verkerk, M. J. (2013). <i>Developing an integrated design model incorporating technology philosophy for the design of healthcare environments: A case analysis of facilities for psychogeriatric and psychiatric care in The Netherlands. Technology in Society</i> , 35 (1), 1-13.	Dementia care.	Integration of ICF, model of Integrated Building Design and Dooyeweerd 15 dimensions to produce model = In2Health Design model.	Unclear how measured.

# A tectonic approach to healthcare- and welfare architecture? The Willow Tearooms as an example

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# Abstract

*Within the last decade, increasing political attention has been put on academic research investigating the influence of architecture on health, care and wellbeing, manifest as a call for operational design strategies. This call is primarily addressed through evidence-based research studies indicating that the quality of architecture influence health and wellbeing. Hence, this attention also raises new demands for architectural practices and a questioning of the role of architects as researchers, which define the scope of this paper. Because, often these evidence-based studies are positioned in quantitative research methods that tend to reduce the aesthetic sensitivity of individual experiences in order to technically measure and quantify the question of atmosphere in the architecture. In addressing this challenge, it is our idea to lend the notion of tectonics, applied in architectural theory as a description of the fundamental task of the architect to fuse aesthetics and technique. We ask ourselves whether a tectonic approach can be applied in positioning and linking the vital aesthetic dimension of architecture to the technically measurable principles in future healthcare-architecture research? This hypothesis is investigated by analysing a historical example, namely the creation of the Willow Tearoom designed by Charles R. Mackintosh in 1903. The unique atmosphere that permeate the interior and furniture design of these tearooms was carried forth by a socio-cultural agenda intended to support and edify the everyday health and wellbeing of the families of Glasgow. It is an exceptional piece of healthcare architecture, and we argue that a tectonic approach has been applied that bridge material, construction, body, mind and socio-cultural dimensions which can be recalled and applied in future healthcare related research as a means to overcome the risk of reducing the aesthetic sensitivity of individual experiences in practice.*

*Keywords: Healthcare Architecture, Tectonic Approach, Material Environment, Atmosphere, Socio-cultural effect*

# Introduction

## Healthcare Architecture

*Can architecture affect our health and well-being?* In 2012, architectural writer and critic Charles Jencks (2012) posed exactly this question on the role of architecture. With the example of cancer patients, and his work with establishing the Maggie's Cancer Caring Centres in Britain, he provided an interesting insight into his own thoughts on how architecture can affect our health, as well as why it matters. He elaborated on how every Maggie Cancer Caring Centre follows the same brief, which emphasize a kitchen table near the entrance so patients and carers can meet informally (Jencks 2012:21). How emotions such as that of feeling unsure of oneself can be met in the architecture by the simple spatial offer to enjoy a cup of tea without committing to anything else. Jencks (2012:25) refers to this as a philosophy of '**kitchenism**'. We find this exemplify the attempt to describe the vital and delicate potential of architecture. The potential to gesture and embrace the needs and desires of the users beyond mere functional and technical practicality. Positioning this delicate potential within the complex debate about health and care related architectural settings is however difficult today.

Other examples engaging in the discussion of how architecture possibly influence health and wellbeing is the literature published by Pérez-Gomez (2016), Mallgrave (2011), Frascari (2012), Ulrich et al. (2008), Frandsen et al. (2009), Fich (2015), Sternberg (2001+2009), Curtis et al. (2007), Delvin and Arnelli (2003), Heslet and Dirckinck-Holmfeld (2007), Kandel et al. (2013), and Kandel (2016). Some of this literature is more polemic, some theoretical and some based on academic research. Still, similar to most of this literature is the interest in the direct and indirect role of architecture on our health and wellbeing. Also, how - as argued for in Tvedebrink (2013:23-25) - research in *neuroscience* within the last 10 years have provided insights on the human brain and the complexities of how we experience, perceive, act, move, think, learn and remember. Consequently, what this type of research suggest is that the human brain is a fully *embodied* entity. An entity, which actively confront the world with its own representational models. Therefore, it no longer makes sense to speak of a 'mind' or the 'senses' as separate from the brain (Damasio 1994, Kandel 2016). However, this increasing interest in the influence of architecture on health and care is not only evident in academic domains. In addition, an increasing political attention has been put on research investigating the influence of architecture on health, care and wellbeing (Balle Jensen 2008). In some cases, the increasing demand for more research-based knowledge has caused a strong focus on addressing aspects of health and care through *evidence-based research* (EDB). A perspective, which in extreme cases make architectural researchers turn away from comparing contexts and collecting insights on user-perspectives to instead adopt so-called 'scientific' quantitative research methods. Methods which are based on conducting experiments, performing interventions and utilising simulations systematically isolating one architectural element (like light, art, and nature view) at the time (Olsen 2009, Tvedebrink 2013, Stankos and Schwarz 2007, Sailer et al. 2008). Unfortunately, there is a tendency that these quantitative research methods reduce the aesthetic sensitivity of individual experiences in order to technically measure and quantify the question of atmosphere in the architecture (Tvedebrink 2013). In addition, such research methods often lack the ability

to capture the importance and value of emotions created as part of collective cultural behaviours and social interactions created with a given context, its spiritual impact and the nuanced role and vital potential of architectural space in this matter (Tvedebrink 2013). Finally, there is a risk of misuse and misinterpretation of such quantitative research results, if they are applied directly as design principles in architectural practice. It is our observation that this growing attention to 'scientific' research and the establishment of 'measurable' evidence raises new demands for architectural practices. As well as a questioning of the role and responsibility of architects as researchers. Especially in describing and positioning this vital potential of architectural space in the discussion of how architecture influence health and wellbeing. Consequently, the scope of this paper, is to engage in the debate of how to go from architectural research and collecting empirical evidence to developing more sensible and even narrated spatial design approaches in practice which are capable of capturing the more emotional and spiritual potentials of architecture? In addressing this challenge, it is our idea with this paper to lend the notion of *tectonics*. The tectonic notion is an approach applied in architectural theory as a description of the fundamental task of the architect to fuse aesthetics and technique, fuse emotion and function – but also to fuse art and science (Semper 1863, Frascari 1984, Frampton 1995). In this way, the notion of tectonics seem to offer a framework to discuss the challenges regarding the relation between health and architecture stated above. Thus, we ask ourselves whether a tectonic approach can be applied in positioning and linking the vital aesthetic sensitivity of architecture to the obtainable technically measurable research results in future healthcare-architecture research?



# Approach and Method

To investigate this question, we need a clarification of concepts and notions. Nevertheless, we also need an example of how to apply such an aesthetic sensitivity in practice. The arguments of this paper is therefore first based on a re-reading of the tectonic theory developed by Marco Frascari in the late 20<sup>th</sup> century. A theory, which addressed both the aesthetic sensitivity and technical construction of architecture. Until now, we have explored this potential in separate research, aimed at either spatial gestures in architecture in general or the theatricality of healthcare eating environments (see Hvejsel 2011 and Tvedebrink 2013). With this paper we explore the merging of this knowledge. By linking tectonic theory with research on healthcare settings into a 'tectonic approach' - an analytical framework and design method - which we propose can be applied in future architectural practice to help overcome the current critical challenge of bridging research and theory with design and practice. The first part of this paper thus presents the development of this 'tectonic approach' at a theoretical level. Whereas the second part applies the described theoretical framework in an analysis of the historical example of 'The Willow Tearoom' designed by Charles R. Mackintosh in 1903. The historic example, in principle unrelated to traditional health and care related settings like hospitals and elderly homes, is chosen because of its sensitive tectonic attention to how the architecture can influence human health, emotions and layers of spiritual perception. Also because we have found no example of traditional healthcare architecture with as clear a tectonic point of departure. The historic example is therefore a best-practice example, which we find, can help illustrate the complex challenge of bringing theory into practice. As well as linking health perspectives with architectural design. Hence, the analysis is limited in scope and should be considered an experiment stressing the aesthetic sensitive potential of architecture. Furthermore, the example is intended to shed new light on the current debate on health and care related architecture, rather than presenting an in-depth spatial-architectural and structural analysis<sup>i</sup>. Consequently, the methodological foundation of this paper is theoretical, historical and conceptually based.

# A Tectonic Approach?

## Remembering the art and science in Architecture

The Greek *tekton* (the carpenter), to whom the notion of tectonics refers was simultaneously the maker and the inhabitant of his house. Thereby inherently engaging in an embodied relation between the form, function and structure of the house (Hvejsel and Beim 2016). Tectonics is as such a notion, which in certain domains of architectural theory, since the mid-nineteenth century, has been applied when analysing and discussing the ethics in- and quality of architectural construction (Frampton 2001). Unfortunately, what could be considered a tectonic approach is in professional architectural practice most often exemplified as large-scale and exclusive iconic building projects with high budgets. And seldom (if ever) exemplified in the everyday, public building projects as healthcare related settings, where severe budget limitations must be met and strict challenges on technical installations and indoor climate demands focus. Hence, it seems to be a need to develop ways of extracting, developing, and applying the tectonic knowledge, often used to state the grandest achievement of the architectural discipline to everyday architectural practices (Hvejsel and Beim 2016). Following this line of thought, healthcare settings is an example of everyday architecture where tight budgets, vast amount of technical equipment, hygiene requirements etc. makes this tectonic challenge especially present.

With the book *Studies in tectonic culture* by Kenneth Frampton (2001) tectonic architectural theory was reintroduced as the structural genius of built environments linked with the ethical role of architecture. This was done on the background of architectural thinkers like Gottfried Semper (1863), Karl Bötticher (1852), Eduard Sekler (1964) and a very sensitive and poetic understanding of the synergy between the visual, tangible appearance of materials and the structural techniques of construction. Frampton (2001) thus aimed to outline a tectonic framework re-establishing a balancing of architecture as art and as function. But also balancing the artistic approach of the architect, the material sensibility of the craftsman and the structural logic of an engineer<sup>ii</sup>.

As argued for in Tvedebrink (2013, 2015) and Hvejsel (2011), a critical reference in relation to the debate about health and architecture in Frampton (2001) is Frascari (1984). With the paper *The tell-the-tale detail* Marco Frascari (1984) presents a perspective that brings tectonic thinking beyond structural genius and visual aesthetics into more socio-cultural dimensions of storytelling, myth and ritual. This is critical because, Frascari (1991:4) also in another paper touch upon the more humanistic values of architecture, stating that:

*“...architecture has to do with the reconciliation between the art of living well and the art of constructing well”.*

Following this, and with a point of departure in the recent developments within neurological science, Frascari (2012b) further argues that elements within both the built- and natural environment impact on our sense of wellbeing. Hence, touching on how we both *sensory* and *emotionally* engage with our surroundings through architectural forms, details and surfaces. With the notion ‘*Cosmopoiesis*’ Frascari (2012a) presents the concept of *world-*

*making* as a way to understand our relationship or response to architecture. Within the understanding of such a world-making Frascari (2012, 1999) touch not only on the dimensions of the tangible, physical built environment and architecture as *construction* (a setting created of materials, structures, and joints), but also on the intangible dimensions of the built environment and architecture as *construing* (an atmosphere created through interpretation, memory and imagination). With this perspective, Frascari (2012) builds on top of an old architectural theoretical tradition where architects like Gottfried Semper (1863) assume that architecture have the capacity to touch us emotionally and take us beyond time and place. But also have a capacity to shape our life by mediating the physical, emotional and socio-cultural aspects of the everyday. Especially when discussing the case of health and care settings, patients often need this space of reconciliation away from treatments. Following this line of thinking the structural 'genius' and 'honesty' in architecture becomes less important. Instead actions of ornamentation and decoration like the use of tapestries, drapery, curtains, panels, screens and decorative motives as part of 'flooring', 'roofing' and 'walling' become important again. Important as part of creating a sense of *interiority* and establish a spatial setting for collective adornment<sup>iii</sup>. Following this, and because of the linkage of the experienced aesthetic quality and technical realization of architecture that is implied with both the theory of Frascari (1984) and Semper (1863), we propose the below three key-notions, as background for an everyday 'tectonic approach':

### 'Theatricality'

*As describing the aspect of atmosphere – referring to the programming of the overall architectural scenery, explaining what it invites for*

### 'Gesture'

*As describing the aspect of construing – referring to the experienced spatial quality of the architectural detail, explaining what it does*

### 'Principle'

*As describing the aspect of construction – referring to the structural build-up of the architectural detail, explaining how it does it*

What the above conceptual notions; *theatricality*, *gesture* and *principle* built upon, is an in-depth understanding of the human scale and our perception of certain architectural atmospheres. Here *theatricality*<sup>iv</sup> is a notion illustrating the overall atmosphere or entire scenery of a setting. It relates to how architectural atmospheres both frames and stages social relations, human behaviour and cultural rituals taking place. The notion also describe how architectural atmospheres are a significant part of festive occasions or joyful events and what makes public spaces inhabitable (Tvedebrink 2013). Relative hereto, the notions of *gesture* and *principle* refers to an aesthetic and structural understanding of architectural details. Details which address both the sensibility of the human scale, as well as transmit a sense of *interiority* to us as we inhabit a particular place (Hvejsel 2011). Therefore, when discussing tectonics and as part hereof architectural quality, a key notion becomes not only the *physical construction* of architecture, but more importantly also the *mental construing* of the architecture. So, how the overall atmosphere and emotional experiences created when engaging in, moving through and perceiving the architecture. With this tectonic approach and the three notions, architecture is not only a frame that needs to relate to a specific site, building tradition and local building materials. Architecture is also a stage of the everyday life of people. Architecture becomes a *scenery* where the interactions of people, the memories rooted in the material environment by the people, and

the wellbeing of people become important dimensions as well. Based on that theoretical framework we will move on to the analysis of the Willow Tea-room. Here we will study whether we can use this tectonic framework to describe the unique ability of architecture to enrich everyday life and health by touching us emotionally and spiritually.

# The Willow Tearooms

## Analysed with a tectonic approach?

The Willow Tea Room, 1903, is the last out of a series of four Glasgow based tea rooms designed by Charles Rennie Mackintosh for Miss Cathrine Cranston, from 1896 to 1917<sup>v</sup> (Grigg 1987, Robertson 1990). Miss Cranston was born in 1849 into a hotel and tea-room empire<sup>vi</sup> in Glasgow (Kinchin 1998). During the last part of the nineteenth century, culinary fashion and changes in public social life in the UK pushed dinnertime into later in the evening. Instead arose a demand among businessmen and middle-class women for refreshments and opportunities to grab a variety of sandwiches, pies, pastries, soups, tea and chocolate in long timespan between Lunch and Dinner. So, during the late nineteenth century eating out for pleasure increases radically (Kinchin 1998:67-68, Spang 2000, Finkelstein 1989), and practices of consumption sparked a series of public interiors in shops, restaurants, hotels and museums which were places of social interaction where 'taste' could be displayed (Sparke 2008, Rice 2007). Simultaneously, during this particular period, we see with the Industrial Revolution a great deal of dust and smog also occurred in European cities strongly influencing the common health and wellbeing among the inhabitants. The streets in some parts of Glasgow have presumably been filled with bad air, dirty streets, blackened exteriors on the houses (Grigg 1987:5,14), and parts of the city was likewise dominated by crime, violence, prostitution, abuse of alcohol and life-threatening diseases such as smallpox and bubonic plague (Kaplan 1996:53). Located on a major shopping street, in-between a series of Victorian-style department stores, was the Willow Tearooms – a four stories tall, narrow infill building completely transformed by Mackintosh (Kinchin 1998, Kaplan 1996).

## Material Environment

The interior of the Willow Tearoom is characterised by a complex series of interconnected spaces bound together across several levels. Upon entrance at street level is located the 'Front Room'; a ladies' tearoom. Behind that the 'Back Room Saloon'. Then a general lunch room characterised by a large light well providing a clear view to the first floor, and the top-lit Tea Gallery. Above the Front Room, in the first floor overlooking the street was the 'Room de Luxe' – a ladies' tearoom with a vaulted ceiling. Finally, on the second floor was a small series of spaces like the 'smoking den' and a billiard room was established for (gentle)men to go and enjoy themselves. In the basement was the kitchen, storage and restrooms<sup>vii</sup>.

The overall spatial quality of the interior is strongly characterised by the varying ceiling heights that opens up for a spectacular view and use of natural daylight. Like with the gallery, or closes in – embracing you softly like with the Room de Luxe and the use of open screens in decorative metalwork. Also by a series of very different table settings, changing dramatically between the Front Room, Back Room, Gallery and Room de Luxe. The detail of the table setting in Figure 1 is a focal point in the overall **theatricality** of the interior. It represents a central **gesture** and **principle** in the overall scenery of the Front Room in the Willow Tearooms. This curious structure was a recti-

linear framework of wood. With an elaborate wrought-iron flower stand on top of it and a circular wrought iron corona above that.



Figure 1. The Front Room, interior detail around table setting (Kaplan 1996:276).

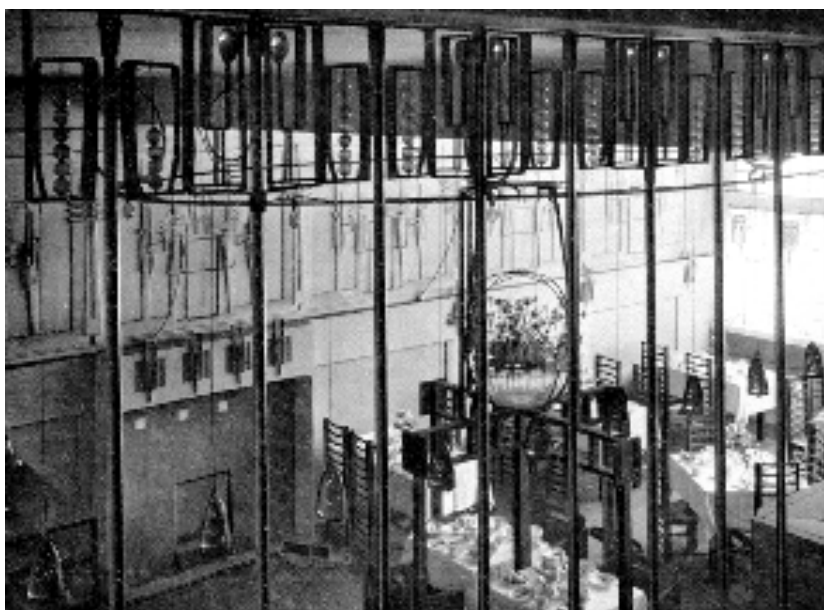


Figure 2. The Front Room, interior detail on wrought-iron balustrades (Kaplan 1996:243).

It is our observation that in this particular interior detail created around two tables and four chairs Mackintosh transforms the ordinary element of a vase of flowers on a dining table into a key interior detail. He uses the spatial effect created with the structural **principle** of the flower stand. Together with a subtle treatment in the flooring, using geometric patterns and a change in colours and textures. Also a marking in the ceiling to form a deliberate spatial transformation. A spatial transformation which offers a sense of enclosure and define a particular intimate place of more private encounters within the overall public space of the Front Room. Relative hereto, he uses symbolism in the artwork of furniture. Iron details to articulate an elaborate play on the willow-tree form. A motif interpreted and applied in an abstract manner by Mackintosh in the entire interior decoration. The motif of course relating to the street name, Sauchiehall, which from the Celtic meaning of Sauchiehall means: "a boggy place full of willows" (Kaplan 1996:274). With this particular detail, Mackintosh developed an imagery that tangibly demonstrated a synthesis of function, technique and storytelling. A synthesis, which together was also meant as an important part of promoting wellbeing. Mackintosh thus created with this interior a fantasy, which seduces or even charm us. While it also brings the ideals of the temperance movement upon the customers. As well as add layer upon layer. It is, as argued for by Macleod (1968:101) "*a curious interlocking of intellect and emotion, of function and fantasy*". Especially, when the design principles are not only based on an admiration for nature, but grows out of a clear analysis of the function.

In total, the Willow Tearoom stands as a theatrical scenery. Here the bold geometric and squared motifs combined with organic curves, artwork and vibrant colours integrated in the glass of the windows, the back of the chairs, the panels on the wall, as well as the decorative screens with an almost fairy-tale quality and smooth paint work all contribute to- and become important parts of the overall **theatricality** created. As described by Macleod (1968), Mackintosh's work is signified by a nuanced layered understanding of architecture. Here furnishing details, wallpaper and fittings are active amplifiers of the architectural envelope itself. Such a thinking stands in stark contrast to existing everyday health and care architecture. This everyday architecture often stands as "empty" white boxes, where we are left with the envelope itself and no articulate interior consideration. So, despite a programming segregating women and men into a series of distinct tea and luncheon rooms, with only a few general areas, the historic example stands as a carefully unified interior. A perfection of everyday subtle detail, where the concept of 'High Tea' is used to facilitate meetings with friends, business partners or other such social gatherings (Kinchin 1998:79). Furthermore, the purpose of Miss Cranston's tearooms, in line with the principles of the temperance movement, was a refreshment-based alternative to the existing bars and drinking clubs. This with the health promotional aim to provide an atmosphere to spark conversation, reading of books and socializing away from "drunkenness" and bad habits (Kinchin 1998, Kaplan 1996:106). Consequently, Mackintosh's work with the Willow Tearoom for Miss Cranston is not only characterised as traditional patronage design. It is also very much defined by an engagement in social responsibilities and a concern for the communities, welfare and public health. The interior design could be seen as an important tool to not only choreograph human behaviour. Also, to combat, psychologically and socially, the threats to society and to re-impose meaning (Kaplan 1996:53). It is a humanistic project occupied with the human scale, which in our opinion strongly changes the responsibility of the architect. Also the ideals behind architectural design.

However, a critique is of course that the interiors created aimed more at a middle-class obsession with health and self-preservation, than the actual

health and wellbeing of the lower working class families. The tearoom was intended as an oasis of light and pleasure in contrast to the smog and crime of the streets. However, the ***theatricality*** of the interior demanded knowledge of the customers. Knowledge about conventions around socializing and fine dining. In that sense, the interiors relate more to a spiritual well-being before physical well-being (Kaplan 1996:60). Consequently, Miss Cranston's tearooms was very different from other similar places of refreshment at that time (Kaplan 1996:285), which developed much more on a nostalgic homely environment.



# A tectonic approach to health and care in architecture

## Theatricality, gesture and principle

As mentioned above, the example of the Willow Tearooms designed by Mackintosh becomes an exceptional historical example of what could be called everyday 'healthcare architecture'. Not only did the tea-room introduce a large amount of people to a sensuous experience of avant-garde interior design. It also bridge material environment and socio-cultural dimensions. A tectonic approach, which we find can be recalled and applied in future healthcare related architectural practice. As well as in architectural research, as a means to overcome the risk of reducing the aesthetic sensitivity of individual experiences. In the below we would like to elaborate on that.

As with the Maggie Cancer Caring Centres, the *theatricality* of the place plays a crucial role. It welcomes and nurtures with a friendly atmosphere. Moreover, as emphasised by Jencks (2012:37) the architecture does this indirectly. It allows for different readings. Mackintosh does the same. He shows us the spirituality and magic of the place. He allows the stories rooted in the material environment to speak to us through the various *gestures* and *principles* applied. Nevertheless, he also shows a deep concern to build around the needs of people who had not only physical, functional and technical needs. Also more cultural, spiritual and social needs (Grigg 1987:13). With the Willow Tearoom, Mackintosh created an interior design with an elaborate control of every detail in both structure, furniture and decoration. In walls, floors and ceiling. It was vigorous and innovative. It is, in our opinion, a timeless architectural quality achieved. Because of this tectonic approach articulating a series of *gestures* and a careful *staging* the social life of Glasgow, deliberately removing the people from the polluted streets of Glasgow, crime and alcohol abuse. Nevertheless, the tectonic approach that we try to emphasize with this paper is not to argue for a *gesamtkunstwerk* or an interior full of symbolic meaning. Instead, what we propose based on the outline of a tectonic framework is to use the conceptual notions of *theatricality*, *gesture* and *principle* to create an approach and perspective, which can both spark positive emotions and provide room for thinking.

There are so many healthcare settings dominated by empty, white walls and what could be considered an absolute minimum of tectonic thinking. Settings with no tangible articulation of materials and joints. No intangible articulation of imagination and emotions. As argued for in Hvejsel and Beim (2016), such buildings (in worst case) appear as merely surfaces and disconnected volumes, rather than inviting spaces that address the human scale. What if the architectural *theatricality* of such public health and care related institutions could provide a more inviting and comforting environment? What if the *gestures* and *principles* of the overall architectural scenery could invite for more social contact and positive emotions? As well as in general improve the experience of the care and caring provided in a healthcare setting?

As argued for in Tvedebrink (2015:122):

*"...the scene of the dinner table has the potential of becoming a significant interior element".*

During various meals the dinner table gathers patients around for eating and it becomes a communal forum. It also offers a unique possibility of relaxation and sense of community otherwise difficult to obtain during hospitalization. Because during mealtime patients have time to interact and talk. The meal has the potential of becoming a spiritual escape away from sickness and hospital treatment procedures. Such an atmosphere can only be achieved if the overall architectural scenery created by the practicing architects invite us to. If the building interior is both constructed and construed to support such social and ritual actions. With this paper, we extend this understanding. From a focus on the overall scenery and theatrically of the hospital department to also including the value and importance of the specific gestures and principles applied. Hence, the subtle changes of materials or patterns in the flooring, walling or roofing that mark an increased awareness and significance to the experienced quality of the space like in the example of the Willow Tea-room. How the subtle spatial *gestures* – as the dinner table - create a gathering point. A place for informal social meetings. But, simultaneously helps create a gentle spatial inclination by directly addressing the human scale. Finally, such an active shaping of structural elements unfolds a potential of the built environment. In practice it is, in our opinion, a matter of utilizing the space and volume, proportions, texture, colour, rhythm and movement to articulate the treatment of the setting. A matter of making a tectonic choice to allow for detailed treatments in the floor or ceiling. Allow to give texture to the surface, adding a subtle sensuous and spatial quality.

In our opinion, the lesson to be learned by architectural researchers, from such a tectonic approach, must be that architectural quality lies not in the specific choice of a style or scientific evidence established. But, could perhaps also be found in the ability to envision and capture the overall theatricality of a built environment. And as an important part hereof, map spatial gestures that through their concrete constructive realization can engage both body and mind. As well as encourage social relations. So, in our opinion, when engaging in the debate about how architecture influence health and wellbeing, and what the future of architectural research and practice should do, it is important to have an eye for the overall programming of the building interior. As well as an elaborate understanding of the spatial relationship between building (interior and exterior) and the public life taking place. Here the 'tectonic approach' becomes the "language" of both the practicing architect and architectural researcher. Which stress the significance of a much more aesthetic-sensitive and user-oriented perspective. But also a method, which address the human scale and socio-cultural layers in a public space. Of course, one could pose the critical question, whether such customization and increased user involvement holds the potential to raise the quality of the complex programming of health and care related architecture? Can a tectonic approach articulate the spatial qualities of health and care related buildings without compromising the strict budgets, complex programming and challenging technical conditions? We think that the task is to find a strategic approach to reposition the primary and vital potential of architecture to enrich everyday life beyond mere practicality. A research approach which lend the notions *theatricality*, *gesture* and *principle* to engage in the intangible, imagined, emotional, and behavioural aspects of architectural environments. For instance by mapping not only the material environment but also capturing the overall atmosphere and user experiences. The above analysis has shown that the development of a tectonic approach can be an important mean in this.

# Conclusion

With this paper, we started out by presenting a critical review of the approach of evidence-based design. We instead lend the notion of tectonics to propose a new more integrated architectural research approach. An approach linking the vital aesthetic sensitivity of architecture with the technical and hygienic dimensions of healthcare settings. Through a historical study, we saw how the unique atmosphere that permeate the exterior, interior, and furniture design of the Willow Tea Room was carried forth by a socio-cultural agenda intended to support and edify the everyday health and wellbeing of the families of Glasgow. Consequently, what Jencks (2012) coined as 'kitchenism' with the Maggie Cancer Centres in our opinion is also evident in the example of the Willow Tearoom designed by Mackintosh. Here we, as argued for in the above, see how the *theatricality* of the overall scenery of the Willow Tearoom not only frame customers buying tea or consuming a light afternoon snack. But also stage important social relations among both businessmen, as well as women and children from Glasgow. In particular, it was our observation, how the interior detail of the dining tables in the Front Room form a central gesture. A gesture which use aesthetic sensitivity, structural principles and material understanding to engage in social responsibilities and create an architectural environment with a concern for welfare and public health. In total providing a careful tectonic treatment of the built environment. But also a carefully orchestrated scenery with a great spiritual significance. A scenery where ceremonial meal rites have been performed collectively to provide hope and improve health and wellbeing among a larger crowd of people.

We have argued that existing quantitative research methods often lack the ability to capture such complexities in architectural atmosphere and user experience. Because they do not operate with the underlying understanding that the experience of architecture is not only created between one person's body and the built environment. But is created in the mix of several persons, places, objects, ideas and interactions across the past and present. The everyday tectonic approach suggested in this paper, is not only a suggestion for an analytical model and a design strategy, but also the first attempt to develop a research perspective that in the future can help address how to capture that complexity and sensitivity when collecting empirical data.

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<sup>i</sup>For extensive studies of the Willow Tearoom see Kaplan (1996), Kinchin (1998)

<sup>ii</sup> According to Perez-Gomez (2016) a split has been brought upon the field of Architecture since the period of Enlightenment, which have separated architecture from craftsmanship and engineering, due to the development of individual professions.

<sup>iii</sup> A perspective that is described at full length in: Hvejsel (2011), Hvejsel and Kirkegaard (2013), Tvedebrink (2013) and Tvedebrink (2015).

<sup>iv</sup> As argued for in Tvedebrink (2013:173), the notion is not to be confused with “theatricalisation” and the illusional scenography or stagesets created in the world of theatre or movie.

<sup>v</sup> The Glasgow Tearooms consist of: 1) Buchanan Street Tea Rooms (1896), 2) Argyle Street Tea Rooms (1897), 3) 205 Ingram Street Tea Rooms (1900), 4) The Willow Tea Rooms (1903,1917)

<sup>vi</sup> The uncle, Robert Cranston, was founder of the Waverly Temperance Hotel, relating to the temperance societies started in 1829 around Glasgow. The temperance movement aimed at helping the working- and middle-class women breaking with the heritage of their alcoholic fathers and husbands (Kinchin 1998). The brother, Stuart Cranston, was the owner of a retail business since 1871 establishing the tea trade between Glasgow and China (Kinchin 1998).

<sup>vii</sup> Later in 1917 another tea room called ‘the Dug-Out’ with a war theme was added in the basement (Kinchin 1998).

# The physical and psychosocial environment's influence on patients' and staffs' perception of person-centered care in forensic psychiatry

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# Abstract

In recent years, large groups of forensic psychiatric patients have been relocated into new medium- and maximum-security forensic psychiatric facilities in Sweden, where a person centred care approach is embedded. A preceeding study focused on the healthcare professionals working in forensic psychiatric facilities who were relocated into the new facilities. That study provided evidence of the environmental effect on staffs' work-satisfaction, perception of work-conditions as well as on their capacity to provide individualized care. From this perspective and on the assumption that physical structures affect the therapeutic environment, a prospective longitudinal study was designed to investigate the impact of the facility relocation of three forensic psychiatric hospitals on patients' perceptions of ward atmosphere and quality of received forensic psychiatric care. Participants were patients over 18 years of age sentenced to compulsory forensic psychiatric treatment. Data were obtained by validated questionnaires. Out of a total of 74 patients who gave informed consent to participate, 58 patients (78%) answered the questionnaires at baseline with a total of 47 patient (63%) completing them at follow-up 1 and 38 patients (51%) completing them at follow-up 2, one year after relocation. The results showed that the new facilities had a positive impact on the patients' perceptions of quality of care and patient satisfaction, indicating that poor physical environment features can have a severe impact on care quality which could be related to a reduced possibility for the staff to perform person-centred care.

*Keywords: Forensic psychiatric care, physical and psychosocial environment, person centred care*

# Introduction

The main purpose of Swedish forensic psychiatric facilities is twofold: (1) to act as places for rehabilitation toward re-entering society, for individuals who have been referred by the courts for assessment or who have been declared as not criminally responsible or unfit to stand trial by the criminal justice system; and (2) to protect society from these individuals. A recent study [1] revealed that the median length of stay for forensic psychiatric patients in Sweden, with and without restriction order, was 951 days, but patients with a restriction order stayed in hospital almost five times as long as patients without. Traditionally, institutional care for forensic psychiatric patients has been arranged according to the medical model [2], in which emphasis is given to the treatment of the underlying pathology that causes the disease [3]. In recent years, however, large groups of forensic patients have been relocated into new medium- and maximum-security forensic psychiatric facilities in Sweden, where a more psychosocial care approach is embedded. In this new perspective, the care is person-centered and conducted in close cooperation with the patient and the patients' family [2]. The design of the physical environment is regarded as more than simply decorative [4]. This is based on the notion that a person's dwelling – her or his 'home' – is of importance for that person's sense of identity, health and well-being, given the home's fundamental role in supporting the basic needs of its occupants [5]. The physical environment can be described in terms of architectural, ambient and interior design aspects. Architectural aspects are relatively permanent, such as a building's layout, room size or window placement. Examples of interior design are furnishings and colors, while ambient aspects comprise lighting, temperature and noise [6].

As research focusing on the relationship between the physical health care environment and patient well-being [7] grows, the environmental design has become known as a therapeutic resource to promote well-being and functionality among patients. In light of this insight, many of those involved in the design and delivery of forensic care endorse the use of non-institutional design features to promote well-being among patients. This endorsement is supported by research findings, where more personalized and home-like caring environments are associated with improved intellectual and emotional well-being, enhanced social interaction, reduced agitation, greater preference and pleasure, and improved functionality of individuals with mental illnesses [8–12]. A growing body of research suggests that the caring environment should also support patients' perceptions of quality of care [13, 14]. Quality of care is a multi-dimensional construct, composed of several related domains, including those of physical, emotional and social functioning, as well as a person's overall evaluation of his or her well-being and possibility to participate in the care [15]. The provision of good quality of care can be accomplished in person-centered care environments that are known to acknowledge the resources, needs, personality, preferences, habits, and cognitive, sensory, and physical limitations of the patients [5, 16].

Within the context of forensic psychiatry, the relocation of patients into person-centered care environments aims to promote their quality of care in the process of moving towards rehabilitation and re-integration into society. Although there is little evidence on the effects of person-centered environments in forensic psychiatry found in the literature, there have been several approaches presented of how to change the environment in forensic psychiatry

to meet the needs of the patients and emphasize the individual's right to define what steps need to be taken in order to achieve health and well-being. Some of these approaches suggest that different aspects of the environment in forensic psychiatry – such as the unit layout, supportive features and finishes, access to outdoor spaces and sensory stimulation – may be linked to better outcomes, including improved sleep, better orientation, reduced aggression and disruptive behavior, increased social interaction, and increased overall satisfaction and well-being [13,17].

Although there is no previous research on the impacts of relocating forensic psychiatric patients to new environments, relevant research in elderly care and general psychiatry leads to the assumption that moving into new care settings may represent a monumental life change for all long-term care patients, and that several adjustments accompanying relocation, such as imposed routines and regulations, may complicate the patient acclimatization [18–22]. Findings are, however, mixed [23], and, according to McAuslane and Sperlinger [24], a more pleasant environment in a new facility may lead to a more positive impact for relocated patients. This finding matches a previous study which also demonstrated that patients affected by dementia appear to suffer few or no adverse impacts from relocation when moved together as intact units of residents and staff [25].

On the assumption that physical structures affect the therapeutic environment, a prospective longitudinal study was designed to measure the impact of the physical and psychosocial environment on psychiatric care outcomes, after the relocation of three forensic psychiatric hospitals in the western part of Sweden, in the county of Västra Götaland, to new facilities. The hypothesis assumed that evidence based design strategies can reduce negative psychiatric outcomes and adverse events among the patients. Additionally, we aimed to study the effect of the working environment and other staff-related parameters, such as competence and experience, on the delivery of person-centered care. Finally, we measured the effect of interventions designed to ensure a secure and safe environment.

Before relocation, the forensic psychiatric hospitals were housed in old buildings, which had been improved and altered over the years to adjust to changing needs. The design of the three old facilities faced both latent implicit and explicit architectural drawbacks, including the following: a series of standardized traditional single-patient rooms, called back-to-back, were laid out on both sides of a hallway in all three hospitals. The rooms lacked individual bathrooms and had deficient ventilation systems. Moreover, back-to-back plans created major transfer noise and vibration between rooms. The lack of windows and of controllable lighting and temperature was also defined as some of the structural failures of the facilities. Furthermore, a lack of access to the natural environment and daylight exposure, either through nature window view or by gaining access to gardens with seating areas, was also recorded. Poor placement of handrails, and inappropriate door openings and furniture heights were also some of the latent conditions registered. The results from baseline measures indicated that both patients' and staff's perceptions of person-centered care in forensic clinics are highly susceptible to factors in the physical and psychosocial environment [26].

The new facilities were based on evidence and experienced based design features from architectural research as well as from the immense experience from the staff and management with the aim of supporting patients' rehabilitation and re-integration into society. All three forensic psychiatric facilities therefor had improved access to gardens, nature window views, and a calm and peaceful environment. Furthermore, after relocation all patients were provided with single rooms with private bathrooms. In addition the common

spaces provided choice seating in order to increase socialization for patients and staff as well as spaces for activity and sports.

In a preceeding study we focused on the healthcare professionals working in the forensic psychiatric facilities who were relocated into the new facilities. That study provided evidence of the environmental effect on staffs' work-satisfaction, perception of work-conditions as well as on their capacity to provide individualized care. Moreover, that study indicated that staff-reported data can be employed in determining their perceptions of the possibilities to adopt a person-centered approach in psychiatric care after facility relocation to a space designed to create a physical environment to support such an approach (*submitted*).

What is still missing is knowledge of the impact of facility relocation into evidence based designed institutions on patients' perceptions of ward atmosphere and quality of received forensic psychiatric care and their views of a person-centered caring environment.

## Aim

The aim of the following study was therefor to explore the impact of facility relocation on patients' perceptions of ward atmosphere and quality of received forensic psychiatric care. In addition we wanted to increase the knowledge whether environmental and other patient-related parameters, such as literacy level and length of care, had an affect on their views of a person-centered caring environment.

## Methods

All patients at the three clinics were informed and asked if they were willing to participate in the study. Data were collected prospectively between 2010 and 2014; before (baseline) and after relocation, i.e., after six months (follow-up 1) and after one year (follow-up 2), respectively.

## Measures

Demographic data included age, gender, place of birth, education, employment history, marital status, place of residence before admission to the forensic psychiatric clinics, previous admission to a general psychiatric ward, length of current admission, and compulsory care during current admission.

The *Person-Centered Climate Questionnaire* (PCQ-P) was employed; a validated patient-reported outcomes instrument designed for evaluating the extent to which a climate (i.e., the physical and psychosocial environment) is perceived as being person-centered (i.e., supporting the person by placing his or her needs and expectations at the center of care). The instrument comprises 3 related domains; safety (10 items), everydayness (4 items), and hospitality (3 items). The domain of safety is related to experiences of being safe in the environment; the domain of everydayness is related to the environment as having an everyday tidy character; and, finally, the domain of hospitality is related to the feeling of welcoming and the sense of perceiving the care and treatment as exceeding expectations. The items are rated on a 6-grade Likert scale, ranging from "I disagree completely" to "I agree completely." The questionnaire is sum scored, and scores can range between 17 and 102, with higher scores indicating a more person-centered climate [27, 28].

*Quality of care* was measured using the Quality in Psychiatric Care questionnaire (QPC). This is a validated patient-reported outcomes instrument designed to measure the quality of care from a patient perspective [29]. The instrument contains seven related domains; treatment (8 items), participation (8 items), discharge (3 items), assistance (4 items), secluded environment (2 items), safety environment (3 items), and specific questions about the forensic clinic (6 items). The last 6 items have been developed for use in forensic psychiatric settings with emphasis on the legal matters surrounding such settings [30]. It included questions on whether the patients have been informed about their rights, or if they have received help to contact the Administrative Court and their lawyers, as well as questions about the staff and doctors' involvement in treatment and crime processing. The items are rated on a 4-grade Likert scale, ranging from "I agree completely" to "I disagree completely". The overall score is calculated as the mean of the individual item scores which can vary between 1 and 4. Higher scores indicate lower quality of care.

### Reliability and internal consistency

Reliability and internal consistency was good ( $0.7 \leq \alpha < 0.8$ ) for both of the instruments and acceptable ( $0.6 \leq \alpha < 0.7$ ) for the third subscale (Hospitality) in the PCQ.

### Statistics

First, we analyzed incomplete data using the expectations-maximization algorithm. Most of the items in the PCQ were phrased so that strong agreement indicates a positive quality. However, all of the items in the QPC scale were phrased in the reverse. In order to make those items comparable to the other items, we reversed the value of the scores so that a higher overall score indicated better quality of care.

Descriptive statistics were calculated for all variables. The scale scores were analyzed by using one-way Analysis of Variance (ANOVA). Furthermore, a pairwise comparison of the scale scores, among baseline and follow-ups 1 and 2, was performed by using Fisher's Least Significant Difference test. Comparisons of the patient overall scale scores between gender, nationality, patients having or not having previous care experience as well as between patients having or not having a knowledge of the treating physician, diagnosis and legal representative were performed by the calculation of Student's *t*-test. All reported *p*-values were based on two-sided tests and compared to a significance level of 5%. The correlation between other patient characteristics, such as literacy level and self-rated health, were examined by using Fisher's Least Significant Difference test. In order to measure the strength of the linear relationship between patient age and length of care and scale scores, we calculated the Pearson correlation coefficient. The SPSS statistical software package (version 20 SPSS, Chicago, IL) was used for all statistical calculations.

### Ethics

This study was approved by the research ethics committee at the University of Gothenburg, Gothenburg, Sweden (Dnr 671-10).

## Results

### Demographics and sample characteristics

Out of a total of 74 patients who gave informed consent to participate, 58 patients (78%) answered the questionnaires at baseline with a total of 47 patients (63%) completing them at follow-up 1 and 38 patients (51%) completing them at follow-up 2. Approximately two-thirds of the participants at each time-point were men, and the age range varied from 18 to 69. The age group 18–29 represented 28% of all patients, while the proportion of patients over 60 years was only 1.4%. The vast majority of the patients reported a previous experience in general psychiatric care (67%) and was, at the time of the study, under compulsory forensic psychiatric care (78%). Finally, 76% of the patients were Swedish.

### Scale score analysis

The patients' perceptions of a person-centered physical and psychosocial environment using PCQ remained quite stable after relocation with only a slight reduction in scores (total scores for baseline = 4.42, follow-up 1 = 4.33, follow-up 2 = 4.29); while in the domain of hospitality (baseline = 4.64, follow-up 1 = 4.50, follow-up 2 = 4.33), the decrease was more distinct. On the contrary, in the domain of everydayness the scale scores tended to be higher at both follow-ups compared to baseline, although they did appear rather low at follow-up 2 compared to follow-up 1.

For the QPC total score there was a decrease from baseline (mean total score = 2.69) in the perceived quality of care at follow-up 1 (mean total score = 2.51) but a weak increase at follow-up 2 (mean total score = 2.75). This indicates that the perceived quality of care decreased six months after relocation but increased 12 months after relocation so that patients perceived the quality of care better at follow-up 2 than at baseline.

It is noteworthy that the patient assessment of the patients' perceptions of quality of care using the QPC was higher at follow-up 1 and continued to increase even at follow-up 2 in the domain of treatment (baseline = 2.50, follow-up 1 = 2.65, follow-up 2 = 2.78). Of the remaining domains, participation and assistance were lower than baseline at follow-up 1 with an increasing trend at follow-up 2, however, remaining lower than results for baseline. These results are in contrast to the scale scores, both in the remaining domains of the QPC as well as for the total score, where, after a temporary decreasing at follow-up 1, an increasing trend was revealed at follow-up 2, with the scale scores being higher than those reported at baseline measures. Finally, the domain of safety environment was evaluated as higher at follow-up 1 with a slightly decreasing trend at follow-up 2.

At follow-up 1 the patients had higher mean scores compared to baseline in the following domains of the QPC: secluded environment (mean baseline = 2.48 versus mean follow-up 1 = 2.52,  $p = \text{ns}$ ) and safety environment (mean baseline = 2.54 versus mean follow-up 1 = 2.94,  $p < 0.05$ ), and lower mean scores in the domain of discharge (mean baseline = 2.48 versus mean follow-up 1 = 1.95,  $p < 0.05$ ). The comparison of the scores between measures performed at follow-ups 1 and 2 revealed increasing mean scores in the domains of discharge (mean follow-up 1 = 1.98 versus mean follow-up 2 = 2.60,  $p < 0.05$ ) and secluded environment (mean follow-up 1 = 2.52 versus mean follow-up 2 = 3.33,  $p < 0.05$ ), however, the mean scores decreased in the domain of safety environment (mean follow-up 1 = 2.94 versus mean follow-up 2 = 2.84,  $p = \text{ns}$ ). Although the mean scores at follow-up 2 were higher compared to baseline in all three domains, only the mean differ-

ences in the domain of secluded environment (mean follow-up 1 = 2.48 versus mean follow-up 3.33,  $p < 0.05$ ) were found to be statistically significant.

### Correlations between patient characteristics and scale scores

The correlation between patient characteristics, such as age, literacy level, self-rated health, nationality, previous care experience, knowledge of the treating physician and diagnosis or legal representative, and scale scores was not found to be statistically significant.

There was a moderate positive correlation between participation ( $r = 0.48$ ,  $p \leq 0.01$ ), specific questions for the forensic department ( $r = 0.44$ ,  $p \leq 0.05$ ), hospitality ( $r = 0.41$ ,  $p \leq 0.05$ ) and QCP ( $r = 0.44$ ,  $p \leq 0.05$ ), and length of care. This indicates a weak trend that longer care length increases the patients' perception of higher quality of care received at follow-up 2. No other correlations between scale scores and length of care were found to be significant ( $p = ns$ ). The level of satisfaction was correlated with both the QCP and the PCQ. This indicates that patients who are more satisfied with the care provided are more willing to be readmitted to the clinic.

## Discussion

The purpose of this study was to assess the impact of facility relocation on the patients' perceptions of ward atmosphere and quality of received forensic psychiatric care by following them, as they were relocated from three 1960s hospital-style, long-term care forensic psychiatry facilities to brand new state-of-the-art, "high-tech" facilities. The physical and psychosocial environment in the old facilities showed several shortcomings that negatively influenced the patients' satisfaction and perception of quality of care, as well as the health care providers' satisfaction [26]. The new facilities seek to promote a collaborative environment with an emphasis on patient health and well-being by incorporating more patient-centered areas. Private patient rooms with numerous windows to add light and air into the space and calming interior tones contribute to a serene and peaceful environment. Access to the outdoors and daylight exposure incorporates natural light into the patients' environment, while a number of public spaces provide the patient with the opportunity to engage in spotlight interactions within the facility's community. Furthermore, a number of these facilities house meditation areas and gardens onsite, which is a further attempt to soothe and rehabilitate through the creation of a peaceful and compassionate environment.

The main findings in this study were that the new facilities have a positive impact on patients' perceptions of quality of care and on patient satisfaction. More specifically, the patients' perceptions of a person-centered physical and psychosocial environment (PCQ total score) remained rather stable, while the perceived quality of care (QPC total score) increased after 12 months of relocation.

Several studies have demonstrated that an appropriate environment, comprising such aspects as staying in newer hospital buildings, has a positive impact on patients' satisfaction of care [31, 32]. Moreover, as patient satisfaction is a major indicator of quality care, another way to assess the quality of care is by mapping out patient satisfaction with care [33]. The above findings are in line with our finding that patients who rated the quality of care as higher were more satisfied with the care provided and were therefore more willing to be re-admitted to the clinic. This result is also in accordance with existing evidence that higher scores on psychological well-being are associated with higher ratings of patient satisfaction [34, 35].

Another important finding of this study was that patients' experience, after a temporary decrease after relocation, showed a higher quality of care (dimensions from the QCP) perceived after 12 months at follow-up 2. In particular, they describe a greater sense of safety in the new caring environment, more opportunities to participate in their own treatment plans, greater assistance provided by the staff and more integrated and personalized care received.

On the contrary, the new buildings were found to have limited positive effects on the patients' perceptions of the ward atmosphere (PCQ), a limitation that has also been found by others [36]. Furthermore, the relocation was found to impact negatively on the patients in terms of being prepared for discharge and the assessment of their possibility of being in a secluded environment when so required. Several possible explanations exist for the above. One possible reason may be the very nature of the ward atmosphere which is, according to Nicholls et al. [37], more than a building or environment. A ward atmosphere may also require social occupation and interaction by the people who move, interactions between the physical environment and the people located in that environment, but also interactions between the people themselves. This challenging and time-consuming process of interaction, prerequisite to improving the ward atmosphere for patients, could explain the variety among patients' expectations across the different domains of the psychosocial environment. While significant improvements were identified for patients in terms of a higher perception of everydayness and safety in the new care setting, a lower perception of hospitality was described.

Another finding of this study was that length of care appears to be an important determinant of patients' satisfaction, with those hospitalized for lengthy periods being most satisfied. This finding is in accordance with existing evidence [38] and it may be because patients feel more comfortable and safe when hospitalized than when utilizing outpatient resources [39].

Finally, an interesting finding of this study was that the vast majority of the patients reported a previous experience in general psychiatric care, though not in forensic psychiatric care. This is in line with results from another study in Sweden [40] where almost 70% of the forensic psychiatric population had previously been admitted to a general psychiatric clinic.

## Limitations

The number of subjects that could be included in the study were limited due to their severe illness. However, conducting research in contexts with patients with severe psychiatric diagnosis is nevertheless important and they should have the same right as other patients to be included in research studies aiming of improving care quality. Even though the instruments used were validated, some of them have not previously been used in a forensic psychiatric setting which could be granted as a risk as well. The fact that the majority of the patients were under compulsory forensic psychiatric treatment, might have influenced their potential to rate more negatively on items due to a general mistrust of the legal and health care system.

## Conclusion

Designing healthcare environments to be person-centered is a significant challenge. This study showed variations regarding the patients' perceptions of the ward atmosphere and of the quality of forensic psychiatric care, indicating that there is potential for improvement in supporting the needs of patients in forensic psychiatric care. Poor physical environment features can have a severe impact on care quality and reduce the possibilities for person-



centered care. However, if the development of new healthcare facilities are based on a dialogue between professionals from health care and architecture, the chances of success increases. In conclusion, this unique study provides evidence that the patients' perceptions of person-centered care in forensic psychiatric clinics are highly susceptible to factors in the physical and psychosocial environment. Moreover this study indicates that the ambition of creating a person-centered approach supported by the physical environment can be detected as patient-reported data of positive perceptions of the quality of the care provided.

### Implications for practice

Supportive features and finishes, appropriate access to outdoor spaces and sensory stimulation, all contribute to patient satisfaction and support staff activities and communication. Other features of the health environment, such as access to the outdoors and daylight exposure, incorporates natural light into the physical environment, while a number of public spaces provide the opportunity to engage in interactions within the facility's community. Furthermore, creating a peaceful environment with lower noise levels contributes to reduced negative outcomes for the staff and improved quality of care for patients.

In a future study we will explore the sustainability of both staffs' and patients' perceptions of ward atmosphere and the person-centered approach in forensic psychiatric care three years after facility relocation.

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