

Design for Effective and Affective Medical Environments

**Inaugural-Dissertation
zur Erlangung des Grades eines Doktors der Philosophie
im Fachbereich Kunst und Design der Universität Duisburg-Essen**

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Tag der mündlichen Prüfung: 18. Juli 2006

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Zweitgutachter: Prof. Stefan Lengyel

To my Family

Acknowledgements

First and foremost, thanks are to Allah who helped me to accomplish this work.

I consider myself privileged to have the supervision of Prof. Dr.-Ing. Ralph Bruder, who made the research possible, during his time as the head of the institute of Ergonomics and design research (IED) at the University of Duisburg-Essen and who is presently the head of the institute of Ergonomics at Darmstadt University of Technology. I would like to express my deepest gratitude to him for his encouragement. His constant feedback and support were fundamental to the structuring and scientific approach of the work.

I would also like to express my appreciation to Prof. Stefan Lengyel, at the Department of the Industrial Design at the University of Duisburg-Essen for his positivity and interest in my work, and for his useful suggestions of improvements.

This research would not have been possible without the generous participation and support of the medical staff members, and patients, who took part in the case studies which were fundamental to the empirical part of the research. All the participants are greatly acknowledged for their collaborations as well as the administrative persons who found the subject of the thesis important and had given the permission to perform the case studies in their health care institution.

Acknowledgements

It has added a lot to my research to have the opportunity to share scientific seminars and discussions with my colleagues at the institute of Ergonomics and Design research (IED) at University of Duisburg-Essen, where this work was conducted. I wish to thank all of them for their positive criticism and critical remarks and comments.

Especially, I want to express my gratitude to Dr. rer. nat. Dietmar Gude, at the institute for Occupational Physiology at the Dortmund University, for his thoughtful ideas and help in the statistical analysis of the immense quantitative data. I also appreciate his support for reading drafts of all my work and contributing with valuable comments.

The interdisciplinary character of this thesis and its cross-cultural nature results from two countries, Egypt and Germany. It has been made possible by the long-term scholarship I attained. Therefore I would like to express my special thanks to Helwan University in Cairo and the Egyptian Higher Education Ministry for their full scholarship in covering all my expenses during the years of my study.

My friend Piera McVeigh, thanks for being kind enough to revise the English under a lot of time pressure.

This research was performed and accomplished with great efforts and has been a focus of my life for some years. Those years were an enlightening and pensive period. However, it was not possible to go through this journey without the direct und indirect support from my family members and friends. I would also like to express my sincere gratitude to my wife, Hoda El Marsafawy, and our son Ali, for all their love, support and encouragement during the years of this work.

Essen, April 2006

Hesham El Marsafawy

Abstract

In the last fifteen years, the term supportive healthcare environment became widespread within the healthcare services, the market stimulated providers to find ways to attract the patients. At the same time, academic research followed with the newly presented focal goal of the relationship between stress and healing as well as enhancing the influence that the medical environments have on patients, staff, and medical work processes.

The concept of supportive environments refers to environmental characteristics that reduce stress and evoke positive responses from their users on physical, social, and emotional levels. The supportive design goes one major step further by emphasizing the importance of creating environments which facilitate the associated work processes. However, the healthcare managers and designers focus the attention to the design of hospitals which are becoming a small constituent of the whole health care delivery system. Yet, nowadays, ambulatory care has become the major player.

It is a fact, that there is a need to focus on the design of medical environments where the ambulatory care is provided. In this thesis it was approached that accurate methods have to be developed which should be used by the designers to define and to recognize the issues of those environments and their influence on the work process and users. In general the relationships between people and the designed environment is the major concern of the ergonomics-oriented environmental design research.

The thesis embraces a broad literature review. That provided an understanding of the knowledge base of designing medical environments. The knowledge base is classified into two main sections; healthcare design and human factors.

In addition to that, case studies that were performed in Egypt and Germany applied a quantitative and qualitative mixed methodology approach, using a combination of methods and tools. The case studies involved purposive sampling from various medical disciplines and healthcare facility types, such as medical offices, medical centers, and outpatient departments in hospitals. The fact that the case studies were performed in Egypt and Germany has allowed cross-cultural differences to be identified. It has been assumed that the natural surrounding (being where the problem occurs) is the best place to study the problem, and also the best way to evaluate the methods used in the investigation.

The approach proposed in this thesis is the design strategy where, first the designer is bridging between several disciplines to built interdisciplinary vision and design considerations, and second mixing the use of methods and instruments to determine what staff and patients do know and what they need in the medical environment.

Environmental design research affects designed spaces, which in turn affect how people use, inhabit, or are exposed to them. On this conceptual background, designing a medical environment is a significant issue for designers. The work presented and the structure of this thesis will support the efforts of designers to create effective and affective medical environments. This concept includes two challenges for designers, creating medical environments to be both functionally effective (“it is going well”) as well as to be emotionally affective (“it is affecting well”).

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Chapter 1

Introduction

1.1 Motivation

1.1.1 The Physical Environment

“The physical environment is the world people live in, move about, and work in” (Beyer, & Holtzblatt, 1998 p.116). The physical environment is the setting which encompasses the people. It has the inherent ability to have an effect on the lives of those people. In today's modern life, it is a fact that we spend most of our times within artificial environments. We live in houses, learn in schools, work in offices, commute in a vehicle, fly in a plane, and so on. As the following example diary studies in U.S. residents show that the typical person is indoors for over 90% of the day (Hedge, a2005).

An total environment is made up of the physical space, along with the people, furnishings, equipment, and actions within that space. In them, we share places with other people, use the spaces in the process of work, and live routines. Sometimes we may find our environments supportive, and we may be able to cooperate or may find ourselves in conflict with using the spaces, and/or to cooperate with the others.

Environments form the settings for all the significant and insignificant events that shape up our lives. They are more than just physical surrounding as containers, they are alive, changing systems, which support or hinder our activities, affect how we look, feel, and act at all times. The environments and the way they are presented give us a message either this message could be negative or positive, please or disturb our emotion. We have strong feelings about them, specially those where important events occur (Farbstein & Kantrowitz, 1978). To this and in that sense, Dilani (2001) said:

“The physical environment affects our behavior; well-designed and positively experienced environments enhance the ability to cope with stress. We react constructively and find better ways to resolve problems if we have a good experience of our surroundings” (Dilani, 2001 p. 35)

The regards given to the physical environment design aspects, which influence our lives, have begun very early. The Roman architect Vitruvius, writing in the first century BC, stated that all the successful public buildings must be built while taking into consideration the following points:

- Durability should be assured when foundations are carried down to the solid ground and materials are wisely and liberally selected.
- Convenience when arranging of the apartments is faultless, and this should be done as to prevent any hindrance to its use.
- Beauty is important so that the appearance of the work is pleasing and in good taste. (cited in (Hosking & Haggard, 1999)

Work does not occur in a vacuum; the following quotation from Beyer & Holtzblatt (1998) summarize the role of the environment over our doing of work in a single sentence:

“Work happens in a physical environment that either supports and enables the work or gets in the way” (Beyer & Holtzblatt, 1998 p. 115).

In most work environments nowadays workers deal with machines, documents, equipment, and other inanimate objects that have no feelings. Cars for example are solids which have no feelings, and that a car repaired in a chaotic, dark, unpainted garage with broken windows would have a chance of being mend professionally “healed” as a car repaired in a glistening and newly appointed garage. The skill of the mechanic is all that matters –even the quality of the work environment is not being considered here and its influence on the mechanic. Applying this same illustration to the medical healthcare environment, people are not cars or machines; while the clinical and technical skills of those treat patients are the highest priority, it is known that people’s judgments and feelings about their environment have a strong impact on the outcomes of the treatment process (Hosking & Haggard, 1999). Medical environments have impact on both the clinical staff and the patients. Medical environments are particular places in which, for most people, many of life’s most important physical events take place. A part from conception, the major happenings of birth and death and the extreme events of diagnosis, illness, recovery or deterioration often take place within these complicated environments.

1.1.2 The Problem of Medical Environments

At present time people in the western world live longer than ever before. According to the German Central Statistics Office, the current average life expectancy is around 81.1 years for a German woman and 75.1 years for a German man. The reasons therefore are certainly to do with medical advancements, as well as the improved in living conditions. Nowadays we are well nourished, have available free time, do less physically strenuous work and get enough sleep. Even so, a long life is not necessarily a sign of healthy life. Daily problems and stress leave their mark on the everyday life and thus sickness follows as a result. Many of these are related to psychological conditions and are becoming increasingly serious (Osten-Sacken, 2005).

Today, the idea of supportive environments to promote health and well-being is widely accepted and is approaching mainstream application. In this sense and in the first place, comes the importance of the physical environment within healthcare is delivered as hospitals, medical centers, and medical offices. Recently, healthcare facilities design has come a long way in a short span of time. A number of relevant volumes have been published, few journals have been created, and healthcare designers both formal and informal have come on the scene.

Lizette Alvarez (2004) states that, if there is one universal truth about hospitals, then it is the fact that they are drab, dismal places, which are not at all designed to heal. He explains further that the furniture is hard-edged and bland. Lights are fluorescent and harsh, and smell of antiseptic is not pleasant (Alvarez, 2004). In addition, there are an ocean of machinery, stretchers, instruments, cables when submerged in a glary light will add to the lack of space and creates insecurity. The functionality of those spaces is also off-putting for the visitors (Monz & Monz, 2001).

Visiting a medical healthcare facility, of any size of those sterile worlds, remains an experience to be feared for most of us. There might be exceptions to this, as one might gain trust from particular environments, such as the Laboratory atmosphere on the one side, builds a level of confidence, but this doesn't necessarily mean that patients readily enjoy this, or are happy to come back. In our increasing life expectancy, the latter will become increasingly more important (Osten-Sacken, 2005).

It could be said, that there is no hope of designing attractive clinical spaces and therefore, no hope that the subject will be taken seriously and its findings implemented (Wells-Thorpe, 2001). However, what the patients seek and need, is not just physical attention, medicine, consultation and physical therapy. The human soul needs company, familiarly, which could be supported by the design of the environment, so as that the person is included (Monz & Monz, 2001). That in one

side and on the other side numerous studies have, in fact, shown that worker satisfaction with the work environment is always a component of over all job satisfaction and job involvement, which are directly linked to turnover, absenteeism, and grievance actions, which in turn affect the productivity of an organization (Villecco & Brill, 1981). In this sense, the staff how provide the clinical care have the right to have more humanized work environments, and that to enable them to provide care that is more efficient.

There is strong evidence that design changes that make the environment more comfortable, aesthetically pleasing, and informative actually relieve stress among patients and increases satisfaction with the quality of care provided. Renovating a traditional waiting area in a neurology clinic by making small changes to the general layout, colour scheme, furniture, floor covering, curtains, and providing informational material and information displays resulted in more positive environmental appraisals, improved mood, altered physiological state, and greater reported satisfaction among waiting patients (Leather *et al.*, 2003) (cited in Ulrich *et al.*, 2004). The interior design of a healthcare facility is critically important to the patient's assessment of the clinical staff and the level of anxiety patient's experience. Patients can rarely assess the quality of the clinical care provider. Nevertheless, a judgment is made based on interactions with staff and an evaluation of the interior environment. Visible attention to detail in environment design generates feeling of confidence about the healthcare professionals who work there and the services that are provided (Malkin, 2002).

Not only the interaction between the practitioner and patient effects the results of the medical procedure, but it is the whole medical environment. It is a "place of healing intervention and care", and they can alleviate stress for their all users, both the staff and the patients. We all know the feeling of stepping into a room where we immediately feel good. Especially, when the autumn is back again with its dull, autumnal days. During such time, the atmosphere is lowered and down (Donnerbauer, 2004). We breathe deeply and don't consciously know that this

positive feeling is having an effect on us- the colour, the light, the scent or the temperature. Rooms have a direct effect on people who enter them. They can speak, tell stories, wake up, be calm, motivate innovative thoughts but also can create fear and experience discomfort (Monz & Monz, 2001). Architects and designers around the world are working to humanize their design of those environments. The idea is: build inviting, soothing health care facilities, with soft lighting, inspiring views, enhancing privacy. Curved corridors and calming waiting areas would ensure that patients will have better satisfaction and heal quicker, supportive staff will remain loyal to their employers and doctors will perform better (Alvarez, 2004). Additionally, more efforts are required to confirm the findings from studies as well as to identify ways to design better working environments that may reduce or prevent the likelihood of errors occurring (Ulrich *et al.*, 2004).

Lizette Alvarez (2004) in The New Times expressed the role of the medical environments, which it should participate:

“Soothing the patients and inspiring the staff” (Alvarez, 2004)

At the same time, Ulrich expressed his vision regarding the role of the medical staff:

“Jobs by nurses, physicians, and others employed in health care facilities often require a complex choreography of direct patient care, critical communications, charting, medical filing, access to technology and information, and other tasks” (Ulrich et al., 2004).

Nevertheless, the staff in the clinical facility wants to offer a good service in an attractive and sympathetic environment and the management’s responsibility should be to ensure that there are systems in place that help them do so (Hosking & Haggard, 1999). Not only the aesthetic aspects have to adapt, but also it should be

ensured that the environment is efficient and support the performing of the work process and that is the role of ergonomics. To this Ulrich and his colleagues (2004) stated that:

“Reducing staff stress by ergonomic interventions, as well as careful consideration of other issues such as air quality, noise, and light, can have significant impact on staff health. In addition, it is also likely to send a message that maintaining health and safety of staff members is an important goal for the organization” (Ulrich et al., 2004 p. 5).

Problems arise whenever design is done poorly, when intended purposes are not met and/or new problems are created. Some of these problems may not seem costly or catastrophic. Yet, the frequencies of their occurrence combined with the fact that designed medical environments are pervasive in our lives; all results have high aggregate costs (Villicco & Brill, 1981). However, one way or another this interested concern is not often translated into action.

Ulrich is professor at Texas A & M University’s College of Architecture. He is an environmental psychologist who conducts scientific research on the influence of healthcare facilities on patient medical outcomes.

Ulrich (2001) states that:

“While reducing staff stress and fatigue through a healing and supportive environment seems like an obvious goal, there are relatively few studies that have dealt with this issue in any detail. More attention has been given to patient outcomes” (cited in Ulrich et al., 2004 p.49).

According to Hignett (2005) a review was carried out to look at the scope of hospital ergonomics by searching conference publications (Ergonomics Society (UK), Human Factors and journals (Applied Ergonomics, Ergonomics and Human

Factors). The results of the review show that the research on the workplace are only 8 per cent of the all ergonomics research of hospitals (as shown in Figure 1):

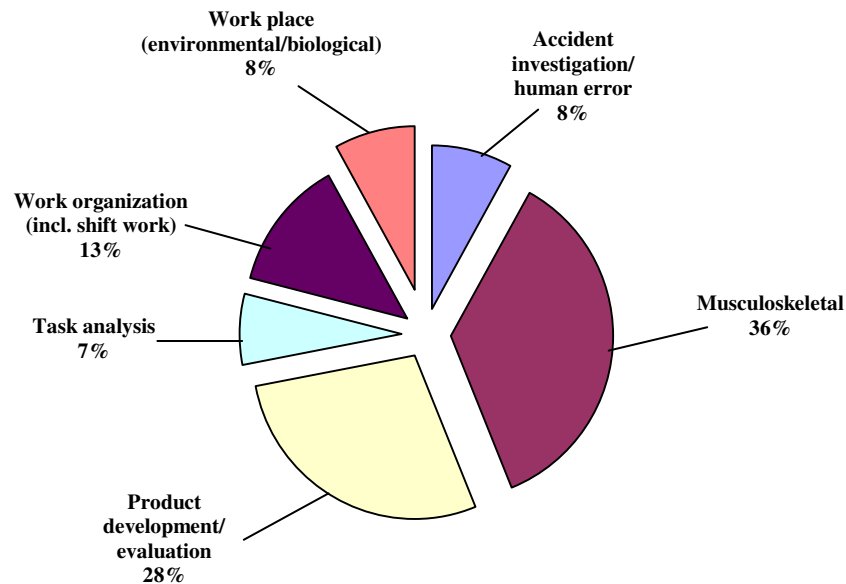


Figure 1: Hospital Ergonomics Research (1989-1990).

(cited in Hignett, 2005)

In hospitals nurses, physicians, and other healthcare employees work under extremely stressful physical conditions (Ulrich *et al.*, 2004). The in-patient requires most an increased amount of care. At the same time, hospitals have a powerful symbolic value in a community: the sense that there is a well-run local hospital is an important part of the mosaic of our local country (Hosking & Haggard, 1999). Therefore, the healthcare managers and the designers give the main attention to the

design of hospitals. However, nowadays the hospital is swiftly becoming a small constituent of the health care delivery system; ambulatory care is the major player (Leibrock, 2000). Ulrich (2001) mentions to the shifts in healthcare demand and facility use pattern, as example for that the increased need for outpatient/ambulatory and long-term care, shorter inpatient stays for acute care, yet greater demand for critical care.

Ambulatory care is provided in out-patient units in hospitals, in medical centers, and also in medical offices. Patients and their families are involved and take an active role in the medical process, they deal and work for most of the time with the same receptionist, assistant, and doctors on each visit, maintaining sense of intimacy even in a high-volume practice (Leibrock, 2000).

Designing a healthcare facility is a significant issue for designers. However, there are some errors, which are most usually made in the design of ambulatory care facilities:

- Designer's ignorance of the client both the patient and staff, which includes the assessment of their specific requirements.
- The neglecting of the necessity of understanding and recognizing the work process properly.
- Ignoring of cultural elements and aspects.

There is a need to focus on the design of medical environments where the ambulatory care is provided, and to recognize the issues of those environments and their influence on the work process and users. In general the relationship between people and the designed environment is the major concern of the environmental design research.

1.1.3 Environmental Design Research

Human beings are engaged in all kinds of efforts to make the world a better place. These efforts include assessing needs, formulating policies, providing solution, developing communities, and solving problems (Patton, 1990). In this sense, the starting point in research into built environment is to focus clearly on purpose that is to add value to the knowledge body of accumulated built environments (Amaratunga *et al.*, 2002). “Environmental design research” attempt to generate knowledge useful to design and design policy in order to improve the quality of life. It raises issues concerning the levels of human aspirations, spirit and perception of the designed environment (Villecco & Brill, 1981). Sisson (1978) put this as follows:

“The environmental design can make a positive contribution to socialization, interaction and moral aspects. It could provide an atmosphere of warmth and cheer for the people who are distressed, apprehensive, and may be uncomfortable” (Sisson, 1978 p. 19).

Villecco & Brill (1981) stated two goals of the environmental design research as follows:

1. To provide useful information in order to improve the fit between the designed environments and people’s performance, satisfaction and well-being.
2. To form new design concepts and develop the design planning processes in order to ensure and realize the intention of the physical environment.

Those two goals are to set a framework for order, to contribute to meaning, and in order to ensure, that the environment should enable relations, interaction and collaboration (Norberg-Schultz, 1988) (cited in Danielsson, 2005).

To enhance the understanding of the issues in the environmental design research, an example can be drawn from the area of industrial design. If it is proposed to develop a new chair to complete a line of office furniture, this is an application of market research and not environmental design research as here defined. The development and testing a new concept of seating that assure health and comfort over prolonged periods of time, however, could be an environmental design research project (Villecco & Brill, 19981).

In the sense of the environmental design research the purpose of this thesis is to assist designers in thinking new ways about the design of medical environments, and especially to consider how improved medical environment design can help increase effectiveness in performing work processes, and also to better understand the perspectives and experiences of patients, families, and staff.

"Designers have to consider what is important to and supportive of patients and families satisfaction, and the differences in their culture context. They should also consider what is important to support staff members in their roles, and what to do to reduce stress and fatigue. The understanding of these issues is essential as a foundation for design planning" (Webster & Johnson, 1999 p. 88)

Alan Dilani is a lecture and researcher at the Karolinska Institute, Swedish National Institute for Psychosocial Factors and Health. He is an architect who has designed various healthcare facilities. He says:

"There is a growing awareness internationally of the need to create functionally efficient facilities that are also human-centered environments aimed at enhancing and initiating health processes "
(Dilani, 2001 p.32)

The relation between the design of the medical environment and the health should not only be seen from the patient point of view, but also from those point of view of the staff. The medical workers health and safety is paramount, as to minimize stress and fatigue triggers, reduce errors, and increase satisfaction and effectiveness. This can be achieved through designing better workspaces which support work processes instead of hindering them. To recognize all of those significant relations and influences more questions rise to the surface, which are being discussed in this thesis.

1.2 Research Questions

The thesis provides an insight to the answers of the following main question:

How do the features of medical environments, which affect the design status, influence the people and processes take place in medical environments?

However broad, this significant question above can be translated, using the design language, into more “*detailed layout*” of specific question groups, as follows:

- What are the specific aspects of the physical medical environment, which cause an increase or decrease in productivity and support or hinder the work processes? Moreover, which specific aspects of those environments effect the staff-patient interaction and communication?
- What are the specific aspects of the physical medical environments, which have an effect on medical staff, cause stress, and influence the mood? Moreover, what are the specific frequently problems facing them because of the design status of their work environment?
- What are the specific aspects of the physical medical environments, which have an effect on the patients and their relatives who use them? Moreover, which changes would like the patients and their relatives to make the medical environments "more human" as to positively influence their feelings?

All of these important questions present challenges for designers, as they provide the changes required for creating a supportive medical environment, and changes in the medical environment so as to be functionality effective, which mean ***“it is going well”***, as well as to be positively affective, which mean ***“it is affecting well”***.

To answer the questions an appropriate methodology is needed; this thesis aims to communicate a methodical research approach to assess and answer the questions set therein.

1.3 Research Approach

Hosking and Haggard (1999) noted:

“A building is the domain of the architects, ergonomists and technicians who prepare the building for the job it has to do, but it is the designer/artist who views these different disciplines in practical and aesthetic relationship to each other. Designers are the “physiologists” of the building world, studying how the whole system work as more than a sum of its separate, specialist parts. ” (Hosking & Haggard, 1999 p. 116)

Reflecting this general approach on the specific field of hospitals and healthcare facilities design, there are many efforts from architects, ergonomists, and technicians, which outline several aspects in the field. Yet once again it is the designer who can view the practical and aesthetic relationships between these efforts from various disciplines. What is needed now is the adoption of an interdisciplinary approach for the design of medical environments, so as to focus them to their end purpose, which is "the creation of optimum conditions that correspond to the

functionality and efficiency of those spaces, as well as safeguard the physical and psycho-social needs of the users involved". A new approach, which deals with the different aspects of the medical environments, is necessary. The articulation of such an approach structurally and in detail, in terms of critical problems, the essential concepts, and the tentative generalizations is also required.

Farbstein & Kantrowity (1978) noted:

"Since the design of the environment can have a major effect on performance, effort, and fatigue, efficiency is often an important design objective." (Farbstein & Kantrowity, 1978 p.117).

There is probably no other area of work, where functionality and efficiency are as important as in the discipline of medicine. In short, it is a matter of ill and health, life and death. Every handle must sit, and all replacements must be accounted. However, while efficient places may be easier to use for some activities, they can be also dull, hard, uncomfortable, and unpleasant (Farbstein & Kantrowity, 1978). The physical environment affects the way in which clinical staff copes with stress. They react constructively and find better ways to resolve problems if they have good experience of their surroundings. On the other side, there are the patients; medical environment will only be successful if it provides the patient with the sense of customer satisfaction. The quality of medical service is also a first priority, yet the built environment is more and more dependant on adapting to the needs and satisfaction of its customers (Malkin, 2002). The medical environment must be able to support patient's psychological and social needs. Additionally, the environment should support the interaction between staff and patients, as well as a more social atmosphere. Unsuitably designed psychosocial medical environments may be source of stress and frustration for both staff and patients.

In addition, the environment where doctors and their assisting staff provide care for patient must comply with the qualities of dependability. For these entire reasons surveyed, medical environment has become a significant playground for designers. The designers in this field bear a greater responsibility. This thesis provides a contribution to an integrated approach towards medical environments design; designs that not only foster functional efficiency in performing the work processes, but which also improve and strengthen the medical staff motivation and the patient's satisfaction. The quality and character of the designed medical environments should be considered to be a powerful instrument capable of improving and strengthening of all activities, relations, and interactions which take place in those environments. There are many work processes and interactions occurring in the medical environments and the success of a design of an environment depends on its suitability to the work processes involved, and its support to the interactions that take place there.

Malkin (2002), who is one of the interior design specialists in the field of healthcare design states:

“As physicians regroup to meet the challenges ahead, competent medical space planners will be needed, and they will be expected to be familiar with new technology, the types of medical procedures being performed”(Malkin2002 p. xix)

Malkin (2002) mentioned here the developments accrue in the field of medicine, which require on the side of the healthcare designers more specific work. In fact, the relation and resemblance between the practice of medicine and the practice of design, or the way designers work and the way doctors work, is very much evident. Yet there are aspects that are more similar. The physicians aim to use different methods to diagnose diseases, they have guidebooks to deal with the different illness. While at the same time the designers use different method to assess the requirements, they have design guidelines to direct them. Methods of assessment and evaluation are basic to the environmental design approach (Paradise & Cooney,

1980). Methods as a scientific approach are of fundamental interest to the purpose of this thesis, because there is a strong need develop an integrated method that is as accurate and efficient as possible.

"Careful listening to the staff and patients, observation of work processes, study of the published literature and wide knowledge of good and bad design in several health care service premises are essential attributes in a health care facility design" (Hosking & Haggard, 1999 p. 50). If we are to obtain accurate measurement, we must develop accurate instruments (Waters, 1980). This thesis adopts the approach, which follows that in order to understand the medical environments; we must become actively involved with the people who work and deal with those environments, as well as recognize the work processes. Thus, we need to develop accurate methods that address problems, relations, and desires across different medical environmental settings. Also required a clear and consistent method for evaluating the artificial places that we create for health care facilities.

Our approach is driven by the following three convictions:

1. The medical environments must be optimized to support the work process and all the users of those environments.
2. The research and evaluation carried out must add to the basic knowledge and understanding of the specific aspects of physical medical environments, which cause an increase or decrease in productivity; influence the efficiency of the work processes; and have effect on patient and their relatives, and also the staff's perception of and interaction with their work environments.
3. The developed method used in the research to identify the user requirements as well as to analyze the work processes, must be communicated to the designers who are concerned with the theme of medical environments.

The general approach of this thesis, with regard to the design of medical environments, has an important influence on the patient, staff and medical work processes. However, many healthcare environments fail to create a positive

impression and hinder the work processes. Hence, several efforts should be made to make significant improvements, set standards and generate methods to create those environments. These efforts should lead to the realization of the goal stated by Dilani:

“Create environments that are not only functionally efficient but also highly psychosocially supportive”. (Dilani, 2001 p. 38)

From the standpoint of supportive environmental design, it is proposed that medical environments, designed to facilitate competent work processes, are most successful when they generate positive affect.

Chapter 2

Basics and Classification

This chapter presents an orientation to the knowledge basis with regards to the subject of designing medical environments. The knowledge basis is classified into two main sections; healthcare design and human factors.

2.1 Healthcare Design

2.1.1 Healthcare Design: Overview

Jain Malkin (2002) wrote that in 1970, as she decided to specialize in healthcare design, she spent many weeks at the library researching the literature on medical and dental space planning, colour and its effect on patients, psychological aspects of illness, studies showing how patients and visitors react to hospitals and why people fear a visit to the doctor or dentist. She was surprised to learn that very little had been written on the matter. She stated that she found nothing of relevance in architecture or design publications. All that was present were a few articles in the

American Journal of Occupational Therapy on the effect of the environment on the patient. Nowadays, she says that probably more than a thousand architects and designers across the country list healthcare design as one of their specialties.

Similarly, after 19 years from the first symposium on healthcare design in California, Ralph Nader said:

"The subject of health care interior design is one that will become more and more specific as time passes." (Nader, 1989 p. 3)

2.1.1.1 Changing Perspectives

New Paradigms for a New Century

The last half of the 20th century witnessed the prologue of new paradigms for a new century, as the physical medical environments were characterized by being spotlessly clean yet lifeless and sterile, all due to focusing on the technologically adapt environments which serve precise treatment procedures. This focus has neglected largely the users of those environments, both the patients and medical staff. Actually this paradigm began to change in the most last fifteen years, as the competition taking place in the healthcare services market stimulated providers to find ways to attract end-users, namely the patients. At the same time, academic research followed with this newly presented focal goal of the relationship between stress and healing as well as enhancing the influence that the medical environments have on the patient, staff, and medical work processes (Stouffer, 2001).

"The term "paradigm" has become such a buzz word among management consultants that the concept means the very assumptions by which we structure our reality" (Miller & Swensson, 1995). Dilani (2001) mentions that in recent years a different perspective emerged leading to a new paradigm. The modern disease concept no longer considers the patient as object, where concentration on individual

“sick parts” of the human body is the normal procedure; rather, the new concept considers disease as a multifaceted phenomenon that has a variety of causes or elements. The new perspective focuses on health promoting processes, and that became much more central to the care philosophies and in the creation of new healthcare facilities. Toward that Dilani (2001) says:

“In this new paradigm, the focus is on the patients: along with their physical health needs the patients’ psychological and social health needs are given major emphasis in the delivery of care activities and in the design of health care environments ”. (Dilani, 2001 p. 31)

According Ulrich (2001) and Miller & Swensson (1995), nowadays the paradigm shifts that drives change in hospitals and healthcare facilities design contain a number of particular trends:

- Strong pressures to decrease expenses yet advance quality.
- The need to take on efficient but expensive innovative medical technologies and treatments that frequently necessitate new facility designs.
- Shifts taking place in healthcare demand and facility usage patterns for example:
 - From inpatient to ambulatory care: increased need for outpatient/ambulatory and long-term care, shorter inpatient stays for acute care, yet greater demand for critical care.
 - From urgency care to Primary care: traditionally, patients with urgent (but not emergency) medial needs have entered the hospital emergency department if they had not established a relationship with a “family physician”. Increasingly, ambulatory care centers have replaced the hospital's emergency room.
- Growing stresses and work demands for healthcare staff. For example, declining staff/patient ratios.

- Mounting demands to increase patient satisfaction as the ultimate end-user.
- Development in the mind/body medicine that has convinced the conventional medical society that anxiety, stress, and other diverse psychosocial factors have a large influence on the overall health and wellbeing of the patients.
- Increasing implementation of patient-centered or family-centered care beliefs, thus necessitating innovative kinds of buildings and organizations.
- The growing scientific research which links well-designed healthcare environments to improved results, poorly designed facilities to worsened outcomes.
- Criticism internationally of much hospitals design as being harsh, distasteful, unpleasant, and stressful.

During the last century issues in healthcare design, we have been confined to merely the aspect of functionality and the adjustment to host new equipment. The principal focus was on practical planning and optimal effectiveness of healthcare work processes. In considering the healthcare work process and the design of healthcare buildings, and taking into consideration the new wider perception that is prevalent in medicine (Dilani, 2001). It is necessary that the psychological and social needs of the medical environment users be strongly accentuated by the side of the long-established economic and biomedical concerns, including infection risk exposure and functional effectiveness (Ulrich, 2001). Health care facilities must be transformed in order to meet the new requirements. Though, in principle, the psychosocial needs of patients and also those of the clinical staff are not new requirements, only recently they have become more apparent to the community of healthcare administrators and designers. The new paradigm shifts aspire to play a vital role in encouraging and supporting patients, rather than discouraging them or amplifying their level of nervousness and concern.

The healthcare system sometimes seems to imply that people should be grateful for what they are receiving and should not ask for more. The argument might go sometime along these lines:

“if we show that we are working in poor conditions, that we are concentrating all our resources on the care and treatment of patients, then the whole world can see that we not wasting money on fripperies and that we still do not have enough resources to fulfill our role properly.” (Hosking & Haggard, 1999 p. 84).

Yet the results of ignoring the patient needs can be the loss of that patient trust in the whole system and its operating bodies.

As an illustrative example for forward hospital design planning given by Dilani (2001), the traditional wards, where the staff are based in a room far away from the patient, will disappear. In modern wards, there will no longer be a nurse station, but instead there will be a centrally placed workstation that is easy to reach, and where the staff would always be available. From this strategically placed spot, the staff would be able to survey and watch a group of patients within a very short walking distance. There the communication and contact between the staff and patients is made easier, consequently generating a feeling of security for both sides. The new paradigm shifts aim to inspire and encourage patients rather than depress them or increase their level of anxiety (Miller & Swensson, 1995).

The New Consumer

The new consumer is more well-educated comparison shopper, empowered by the internet, with analytical ability to review research and form an opinion about treatment options. Malkin (2000) demonstrates (geographically speaking of the USA population) that this group has grown from 25 percent of the population 20 years ago to 45 percent today. By 2005, they will constitute 52 percent of the population.

Maybe the percentages are different in Germany or in Egypt but the meaning remains the same. Malkin (2002) mentions further a report delivered at the Healthcare Forum Summit 1998, that the new consumer has three universal beliefs:

- Doctors can be wrong.
- People know their own bodies best; self reliance is wise.
- Quality is important, and consumers want the best for less; value is being redefined.

The empowered consumers arise now as new factors which have to be taken into consideration by the administrators of the healthcare services. The recently emerging knowledgeable patients make them more aggressive than submissive with regard to their demands. The new age consumers have now the motivation and education to research about their healthcare problems, and they have the ability to understand what they are reading. At the present time is it normal for a patient to arrive at his/her doctors' office equipped with all the information and data necessary to discuss potential diagnoses and treatment options. The patient now has a choice, and researches for a healthcare service with a critical eye, one that is experienced.

Particular example from Europe is provided in the Design Report Publication, by Ernestine von der Osten-Sacken (2005). He stated that many German patients who for many years left their health entrusted with their GP or "trusted family doctor" are now more and more taking responsibility for it themselves. The deep-rooted upheaval in public health is being more frequently pointed out by patients in a considered and mature way. It's no longer the case that it's only the passive sufferers that are putting in claims, but instead those who are in the choice of medical services. Eventually, whether they want to or not. At the very end, they'll pray to their health insurance company. Alongside this development, the patient-doctor relationship is changing too. The patient is a customer these days, who in themselves are part of a target market. All previous medical experience aside, they also must market themselves and advertise themselves, in order to properly position

themselves. Even when advertising in the health market is becoming almost necessary, the patient as a consumer, is restricted by the available choice. Malkin (2002) puts the patient-doctor relationship adequately when saying:

“When we look back on the decade of the 1990s, policy makers will feel any shame about having turned physicians into hamsters who are running faster and faster on a wheel to only stay in place, measuring their production by time and motion studies, thereby reducing a valued patient-physician relationship to a commodity” (Malkin, 2002 p. xviii).

In the past, the patients went to the family doctor with whom they had grown up with, or they selected a practitioner in the nearby locality. However, with the mobility that characterizes the society nowadays, people move repeatedly, thus making the long-standing relationship with the healthcare providers something that is not practical (Malkin 2002).

Alvarez (2004) mentions that the idea of building hospitals that help rather than hinder recovery is beginning to gain support in Europe, Britain, which has some of the oldest, drabest hospitals in Europe, is in process of building 100 hospitals by 2010 and is paying close attention to their design. Alvarez (2004) reported about the university hospital in Oslo, which moved four years ago to a new building. From the outside, the building is rather un-dramatic, built of golden brick, with a tower near the entrance and piazza-style courtyard for dropping off patients. It is the inside that has won it accolades. The important thing is that since it opened, the hospital has nearly doubled its number of patients and lowered its employee turnover and absentee rates, said Age Danielsen, its administrative director (cited in Alvarez, 2004): “Patients give us the highest scores,” he said “we didn’t think it would have such a dramatic effect”.

Christian Schoenwetter (2005) reported from an ENT (ear, nose, and throat) practice in Stuttgart that “with their individual design, the practice differentiates itself from many others and provides the doctor with a small advantage in winning customers”. Naturally, the designer is no substitute for the qualifications of the doctor. If a patient has the choice between two medical practitioners, with both he’s quite happy with, he will choose the practice with the more pleasant, designed, ambience.

With regard to the medical quality of care, the awareness of the patient places an increasing need to apply and offer a more clearly-defined market direction. Service, architecture, as well as the designed appearance are important cornerstones for this. More and more medical staff are giving weight to offering their customers a pleasing ambience. The sterile atmosphere is “Out” written by Osten-Sacken (2005). He drives an example on established houses, like the Berliner Charité or the University Clinic of Hamburg-Eppendorf, where the administration readily accepted this, and had their corporate design professionally worked on. More and more of ordinary doctors are giving worth to the “designed surgery” in order to offer their customers a pleasant ambience. Even manufacturers of medical equipment have seen the sign of the times. They employ designers to gain different perspectives on aspects such as functionality, hygiene, and to consider the patient’s own various feelings in its design.

Christian Schoenwetter (2005) comments “we hate to admit it: the health reform has its good sides”. He means that, since the introduction of medical practice fees (patients must pay 10 Euro every 3 months when they visit a doctor), patients are going less often to the doctor, meaning that many doctor’s offices are yielding a smaller turnover and thus are sustaining losses. On the other hand, doctors are undertaking more and more to connect with patients (who are becoming customers)

or to attract new customers. More frequently, the doctors are investing in design for their practice, by which they gain an advantage over the competition.

Christian and Michael Sieger point out the demands placed on the interior design of a gynecological practice:

“friendly ambience and pleasant working conditions. A concept that combines well-being with the professionalism of medical services was therefore developed in close coordination with the practice team.”(Sieger & Sieger, p.38)



Figure 2: “Do you have something for the human condition?”.

By Mel Calman (from Hosking & Haggard, 1999 p. 188).

Architect Hofricchter says (cited in Donnerbauer, 2004):

“The hospital will only be successful if it gives the patient a sense of customer satisfaction. The quality of medical service are is also a first priority but the built structure is more and more dependant on adapting to the needs and satisfaction of its customers. The hospital must orientate itself towards a hotel model, in order to develop a modern service for people.” (Donnerbauer, 2004 p. 41)

2.1.1.2 Environment and medical Outcomes

Do the aspects of lighting, temperature, sound, colour, room layouts and furniture in healthcare facilities affect patient’s ability to recover from illness better and in shorter time? Do they affect the staff with reducing the stress and motive their ability to provide quality care?

The answer is Yes. According to Cortvriend (2005) the environmental factors influencing the physical and psychological health of patients play a significant role in decreasing the feeling of fear and stress feelings and increasing those positive feelings and emotions. These factors have also a significant impact on the staff as they can add to their stress levels and increase the risk of error (Cortvriend, 2005). Tony Monk, a British architect in health care design states:

“The environment of a hospital contributes to the therapy of the patients... People are mentally vulnerable when they come in, (he means in hospital), and if they are beaten down by an awful, dreadful, concrete, uninteresting, poor building with poor colours, it makes them even worse” (cited in Alvarez, 2004).

Ulrich is professor at Texas A & M University's College of Architecture. He is an environmental psychologist who conducts scientific research on the influence of healthcare facilities on patient medical outcomes. Ulrich (2001) points out that social support and pleasant distraction or entertainment has now become a much more important considerations in creating new healthcare facilities and organizational models for delivering care. By contrast, the traditional pathogenic perspective implied that the main requirement placed on healthcare facilities should be construed narrowly as the reduction of infection or disease risk exposure. Ulrich (2001) mentions the work of Haya Rubin and her associates at the Johns Hopkins Medical School evaluating the status of research on the environmental design/health relationships. The investigators located more than 85 published studies, which met criteria for scientific rigor, such as using experimental design with random assignment. Rubin and her colleagues observed that this amount of research is small by the standards of established medical fields, but enough quality research has appeared to justify the conclusion that *"there is suggestive evidence that aspects of designed environment exerts significant effects on clinical outcomes for patients"*.

Malkin (2002) points out how the environment can decrease the arousing fear and anxiety during the examination and treatment procedures:

"The environment must be clean, cheerful, and non threatening, with contemporary furnishings, pleasing colours, interesting texture, and compatible works of art" (Malkin, 2002 p. 1)

Ulrich *et al.* (2004) mention that a considerable body of research has documented negative effects of noise on patient outcomes. Several studies point out that higher noise levels, for example, decrease oxygen saturation (increasing need

for oxygen support therapy), elevate blood pressure, increase heart and respiration rate, and worsen sleep. Research also shows that patients who can see trees instead of cars from their windows recover more quickly. In addition, studies strongly support that bright light—both natural and artificial—can improve health outcomes such as depression, agitation, sleep, circadian rest-activity rhythms, as well as length of stay in demented patients and persons with seasonal affective disorders. It has also been shown that patients in brightly lit rooms have a shorter length of stay compared to patients in dull rooms (Ulrich *et al.*, 2004). Not only, but the design of the physical environment strongly impacts hospital-acquired infection rates by affecting both airborne and contact transmission routes. Evidence-based design measures, by reducing nosocomial infection rates, play a key role in shortening hospital stays (Ulrich *et al.*, 2004). To this, there are many books and research dealing with the theme of the therapeutic environments which is supportive of the people confined within and which enhanced treatment.

2.1.2 Ambulatory Care Facilities

Not very long ago, the medical scene was separated into hospitals and doctors' offices. Nowadays, the hospital is swiftly becoming a small constituent of the health care delivery system; ambulatory care is the key participant. In solidifying their positions, outpatient care is now being offered by hospitals in many hospital-based ambulatory care centers, independent centers, and on health campuses. (Miller & Swensson, 1995) (Leibrock, 2000).

2.1.2.1 Types and Subtypes

Figure 3 illustrates the medical care network, starting from hospitals to the medical practices at the end of the network.

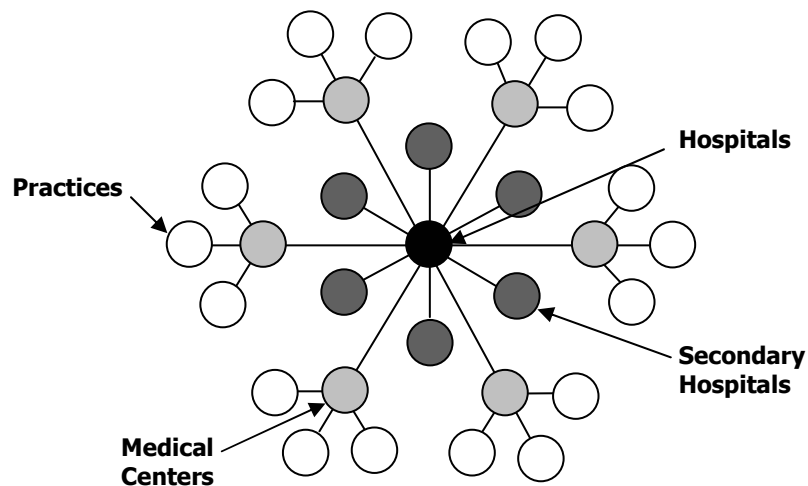


Figure 3: Medical care network

Primary care

The field of medicine is continually expanding as new knowledge and concepts are put into practice. But at the base level of the health care delivery system, the primary fields of medicine are:

- General practice
- Pediatrics
- Family practice
- Internal practice

Physicians in these areas are responsible for the total healthcare needs of their patients. They are termed “primary” medical specialties because they are normally the entry-level physician one would consult about a medical problem (Malkin, 2002).

Medical specialties

Medical specialties (according to the American Board of Medical Specialties:

- | | |
|-----------------------------|----------------------------------------|
| 1. Allergy & Immunology | 13. Orthopaedic Surgery |
| 2. Anesthesiology | 14. Otolaryngology |
| 3. Colon & Rectal Surgery | 15. Pathology |
| 4. Dermatology | 16. Pediatrics |
| 5. Emergency Medicine | 17. Physical Medicine & Rehabilitation |
| 6. Family Medicine | 18. Plastic Surgery |
| 7. Internal Medicine | 19. Preventive Medicine |
| 8. Medical Genetics | 20. Psychiatry & Neurology |
| 9. Neurological Surgery | 21. Radiology |
| 10. Nuclear Medicine | 22. Surgery |
| 11. Obstetrics & Gynecology | 23. Thoracic Surgery |
| 12. Ophthalmology | 24. Urology |

2.1.2.2 The functions of Ambulatory care Suite

The functions of the ambulatory care suite are divided as follows:

Administrative

- Waiting and reception
- Business (appointment, bookkeeping, insurance, clerical)
- Medical record

Patient care

- Examination
- Treatment/minor surgery
- Consultation

Support Services

- Nurse station/Laboratory
- Storage
- Staff lounge

2.2 Human Factors

2.2.1 Man and Place (Environmental Psychology)

What are places? To this Farbstein and Kantrowitz (1978):

"Places are all around us, from alcoves, bars, churches, and hospitals to yards and zoos. Places are not just rooms, buildings, or out-door spaces, but total environments made up of physical spaces together with people, furnishings, machines, and actions. Places form the settings for all the significant and insignificant events of our lives. More than just containers, they are living, changing systems which support or hinder our actions, please or disturb our emotion" (Farbstein & Kantrowitz, 1978 p.1).

2.2.1.1 Sensing the Place

With regard to sensing the place, we humans have five senses; hearing, smell, sight, touch and taste, through which we become acquainted with the physical world. As we become familiar our surroundings, our sense conveys to us all the information which we receive from the environment, whilst our brains creates significance to that information. Our ears hear a range of sounds. Visual perceptions act as strong sensory items which immediately transfer the particular image to our brain both actual and mental. On the same level are sounds that tell us a lot about the size of the space and what is happening within that space. Places have characteristic sounds which we can learn if we tune in and listen carefully. Part of what makes a place seem familiar is recognizing its distinguishing sounds. Moving on to an another sense, touching different items gives us a wide variety of sensations, for example: a cold stove, a hard stone, a yielding sofa, a warm plate, damp grass, and so on. Touching enriches and confirms what we see and hear. We learn a great deal about

what our places made of by touching. Our sense of smell plays a role in this too. The different places may smell dry, fresh, old, or stuffy. We can also taste places or, more likely, the things in them. The brain finds all of this information, processes it, and creates sense for us. The human brain has the ability to select and organize this information into stable, recognizable images of places which we interpret in terms of our shared cultural experience. We not only perceive places and act on the basis of the information, but we have strong feelings about those places we interact with. Each of our senses brings us a particular kind of information, a unique part of the overall picture (Farbstein & Kantrowitz, 1978). Hosking & Haggard (1999) describe the unique possibilities and limitations of our senses:

“In fact, a very large proportion of our information about places comes to us through our eyes; as light, colours, shapes, things, material, textures, and people activities. With eyes we are able to judge distances, to orient ourselves, and to move around easily in space. What we see makes a difference to our confidence and sense that we are in a good or poor place” (Hosking & Haggard, 1999 p. 167).

2.2.1.2 A Place to Love, a Place to Hate

Different places stir within us a mixture of feelings; we have strong feelings about the places we enter almost instantly. While some places make us feel well, others make us feel entirely the opposite. At times we might feel happy, comfortable, and warm, while at others we might feel sad, sore, and cold. The places we love we always try to return to them often as we can. The places we hate we intentionally avoid them, as not to sustain any discomfort from being there. It is a fact that our emotions about certain places are composed from a blend of responses to the physical nature of that place and to what is happening, or has happened, to us within that place. While the assurance given beforehand, or a memory of a past pleasant

experience, can make a neutral or even miserable environment attractive, an unlikable event can convert a nice place into one we fear returning to. On the other hand, physical properties can in themselves make places agreeable or disagreeable. Separating out those two aspects -the psychological aspect within us and the physical aspect of the place- is not an easy task since places are multifaceted wholes that unite physical and human qualities. People react in a different way to the same place; one person might feel affection for a place while another might hate that very same place. The size, shape, and arrangement of spaces and objects play a crucial role in how we react to places and use them. Although we share our feeling about places with other people, dissimilarity in reactions results from variations in personality, cultural values, and past experience. Such values and preferences lead people to prefer certain places over others, and even change them to suit them in a way or another (Farbstein & Kantrowitz, 1978).

2.2.1.3 Unity and Complexity Balance

If we measure balance by the visual information rate contained in a space such as room, as it is perceived through the optical system, two opposite poles can be identified one called unity and the second called complexity. Unity involves various components and parts fitting together into a coherent unit. Complexity involves more variation. Extreme unity (monotony or sensory deprivation) can lead to understimulation, and extreme complexity to overstimulation. Exposure to over stimulation can cause changes in the rate of breathing, pulse rate, and blood pressure; increase in muscle tension; psychiatric reaction of varying types; and probably complicate medical consequences, such as increased susceptibility to infection, coronary disease, and ulcers (Mahnke, 1996).

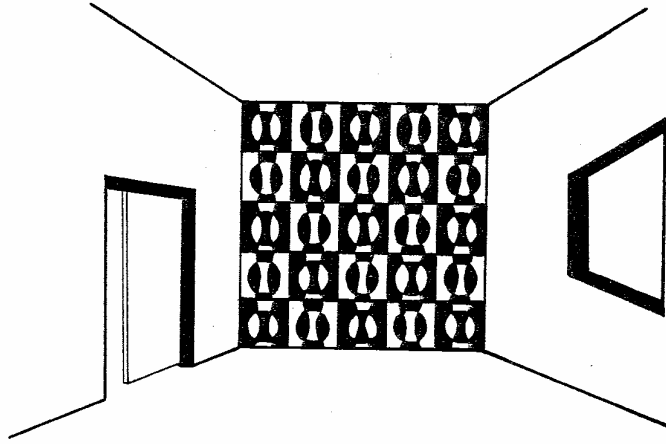


Figure 4: Too much visual pattern will overstimulate an environment (from Mahnke, 1996).

It is interesting to note that the heart response was lower in a colourful room than in a gray room, when an experiment has been conducted by Rikard Kueller in 1967 on the effects of two opposite environment (cited in Mahnke, 1996). In that experiment which was made over a period of three hours, six men and six women were placed in two rooms that differed in visual complexity and visual unity. One room was gray and sterile; the other, colourful and diversified. The experiment demonstrated that the colouring and visual patterning of an interior space can have a profound effect on an electroencephalogram (EEG) and pulse rate, as well as on the subjective emotional feeling of a person. The heart rate was lower in the more colourful room than in gray room. Therefore, a dull environment tends to make us turn to our inner self, since the exterior provide no stimulation. This, in certain circumstances, may induce anxiety, fear, and distress, depending on the particular situation we are dealing with, and the nature of our thoughts. On other hand the over stimulating environment tends to cause over excitation and that is distracting and

fatiguing. Strong colour, too much visual pattern, and a high degree of brightness demand voluntary and involuntary attention. Vivid design in work areas can impair productivity by seriously interfering with work tasks that require visual concentration (Mahnke, 1996).

From the above, it is concluded that an under stimulated environment is just as unacceptable as the over stimulated one. The need to balance harmony and complexity is one of the main confrontations designers deal with, and finding a solution to that particular problem is of great importance, as to strike the perfect balance and achieve the desired effect in the designed place.

2.2.2 Ergonomics Approach to Workplace Design

"A workplace has been defined as "a location where a person or persons perform tasks for a relatively long period of time" (Cushman *et al.*, 1983 p. 14). Others have defined the workplace as "a place which contains the space, tools and equipment where workers perform the functions and tasks of their jobs" (Ayoub & Miller, 1991 p. 67).

Considerations for the design of workplace are discussed in several references (usually industrial work place), and in this section the general consideration will be presented to be useful as content of "primary" guidelines for the design of workplace.

2.2.2.1 General design considerations

Cushman *et al.*, (1983) point out general considerations when laying out a production workplace or office area:

- Service needed by several people should be placed in a central location.

- The communication needs of different operations should be evaluated, and people or workplaces should be located so as to maximize communication.
- Lines of sight and other visual requirements for operations should be kept clear.
- Noisy, heat-producing, door-producing, or visually distracting operations should be modified or located so as to minimize their effects on other operations.
- The work area should be arranged so that the product can flow through it, preferably in one direction, with minimal remanding.
- Offices should be designed to permit people a minimum separation of 122 cm, with 244 cm being more desirable.
- Postural flexibility and change should be provided; a person should not be restricted to a workplace in such a way that he or she cannot change posture during the shift.

Das and Grandy (1983) (cited in Ayoub & Miller, 1991) listed several necessary features for the optimum workplace. The optimum industrial workplace must include:

1. adequate postural support
2. proper body and limb weight distribution
3. natural limb positions
4. Positions should require little demand for maximum reach or force in the performance of job.

These points mentioned above are the definitive goals any workplace design hopes to achieve for all its users.

The concept of work tolerance discussed by Tichauer (1978) is another useful view of the optimum workplace from a slightly different angle.

“Work tolerance is a state in which the individual worker performs at economically acceptable rates, while enjoying high levels of emotional and physiological well-being” (cited in Ayoub & Miller, 1991 p.70-71).

Prerequisites of biomechanical work tolerance (from Tichauer, 1978 cited in Ayoub & Miller, 1991)

Postural

1. Keep elbows down.
2. Minimize moments on spine.
3. Consider sex differences.
4. Optimize skeletal configuration.
5. Avoid head movement.

Engineering

1. Avoid compression.
2. Avoid critical vibration.
3. Individualize chair design.
4. Avoid stress concentration.
5. Keep wrist straight.

Kinesiological

1. Keep forward reaches short.
2. Avoid muscular insufficiency.
3. Avoid straight/line motion.
4. Consider working gloves.
5. Avoid antagonist fatigue.

2.2.2.2 Specific considerations

Anthropometric aspects

"Anthropometry has been defined as the science of measurement of body size. The application of anthropometry is an essential element in the process of designing the workspace to fit the worker. The physical size of a population can be determined by measuring body lengths, breadths and girths, and the data derived can be used to design workplaces, equipment and products which match people's dimensions. In this way the workspace (which includes the equipment, tools, furniture etc) can be fitted to the man or woman's physical dimensions and functional capabilities" (Nicholson, 1991 p.3).

Taking this into consideration, the variations in the differing size of humans body are always points requiring attention by the workplace and equipment designer. Solely designing items for use by the "averagely sized" person is also unacceptable. Importance has to be given to those people in the population who are below the average norms or above them, so as to avoid discrimination when it comes to the usefulness of the equipment designed. Some however might disregard those outside the norm (Grandjean, 1980):

"It is usually not possible to design workplaces to suit the very biggest or the very smallest workers so we must be content with meeting the requirements of the majority. A selection is therefore made, usually so that the extreme body sizes are disregarded."
(Grandjean, 1980 p.33)

The anthropometric characteristics of the user population are distinguished by two distinctive types of data; the static (also known as structural) data that deals with

the measurements of the bodily dimensions of subjects in a fixed position in relation to one clearly identifiable anatomical landmark to another or to a fixed point in space (ex. the height of the knuckles above the floor, the height of the popliteal fosse, or back of the knee, above the floor), and the dynamic (also known as functional) data that deals with the body measurements in relation to an external object or compared with the dimensions of an external object (for example arm reach boundaries are used to determine the positions of hand controls and switches) (Nicholson, 1991) (Kroemer *et al.*, 2001).

There are several ergonomic literatures which provide tables for both structural and dynamic data for different populations over the world, such as the work of Bridger (1995) "introduction to ergonomics".

These are measurements of the bodily dimensions of subjects in fixed (static) position. Measurements are made from one clearly identifiable anatomical landmark to another or to a fixed point in space (e.g. the height of the knuckles above the floor, or back of the knee, above the floor, etc.)(Bridger, 1995).

2.2.3 Cooperative Activities

Cooperative activity of the staff as teamwork and collaboration is a highly relevant and valuable topic of concern for human factors practitioners. It include studies of individuals and groups at work to establish greater effective performance among individuals and also teams through minimizing wasteful effort and enhancing coordination and team work in complex work environments. This goal can be achieved in several ways, as use of techniques (computers and communication techniques), training, and also the design of workspaces and workplaces.

2.2.3.1 Work flow Patterns

Xiao & the Lotas Group (2001) mention that the workflow patterns could be categorized in four types:

- Pooled/additive: in which there is no work flow among members of team;
- Sequential: in which work flows from one team member to another, mostly in one direction;
- Reciprocal: in which work flows from one team member to another in both directions over a period of time;
- Intensive: in which there is no sequential work flow, but the team's task require joint cognitive activities such as diagnosis and problem solving.

2.2.3.2 The Cooperative Activities and the Physical Layout

"Expert reasoning tends to move from global description of functional goals to detailed specifications of particular actions on specific components" (Flach & Kuperman, 2001 p. 263). The work activities of a person or a team of workers are rarely individual-oriented action (Rogers & Ellis, 1994). Those actions resultant from the business social interactions with others and also with the physical surrounding in which they occur. Therefore it is important to understand the cooperative activities in the two directions of social interaction and physical surrounding as shown in Figure 5.

Figure 5 shows how different aspects of a task analysis fit within the overall analysis space defined by the abstraction and decomposition. Reasoning down the diagonal help to reveal the rationality that determines why things are done. Reasoning up the diagonal help to reveal the causal relations that determine how things are done (from Flach & Kuperman, 2001).

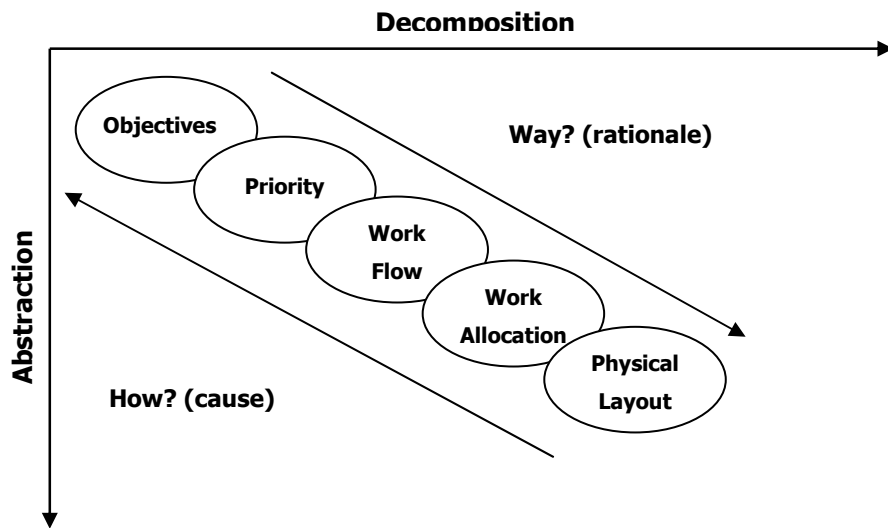


Figure 5: How different aspects of a task analysis fit within the overall analysis space defined by the abstraction and decomposition.

(from Flach & Kuperman, 2001 p. 263).

2.2.4 Stress in the Physical Environment

A large percent of the working population spends at least 40 hours per week at work within premises of his/her workplace. In some countries, such as in Egypt, most of people work for six days per week, which equate to approximately 48 hours. The work environment exerts a significant impact on the everyday life of the majority. It is clear that the work environment could have an negative impact on employee's health and emotional wellbeing. Nonetheless, conceivably it is not only the psychosocial environment at work that has a negative impact, but also the physical

environment has one. Therefore it is appropriate to look at the relation between the physical environment and the triggering of stress (Danielsson, 2005).

2.2.4.1 What is stress?

Stress is regarded as a stimulus that is a condition that generates a reactive change. In recent thinking, stress has come to be regarded as an organism-environment transaction. The model that stress viewed as a transaction is extensive, as it takes a broader approach to the conceptualization of stress to account for both the internal and external stress, environmental demands are seen as the external events and conditions which elicit stress response, and the goals, values, commitments, and so on, which are acquired by the individual and whose thwarting might elicit a stress response make up the internal determinants of behavior (Fontaine, 1980). According to on-line health and safety manual (without year), If demands and pressures (“stresses” and “stressors”) become too great, they can induce, in anyone, the harmful or potentially harmful mental and physical feelings and reactions commonly known as “stress”. Insufficient demand as well as over demand can contribute to a stress situation. The severity of the stress will depend on the mismatch we perceive between the demands and our ability to satisfactorily respond to them and also our perception of the possible consequences of failing to do so. It may also be affected by our fitness and resilience at the time.

2.2.4.2 What are the effects of stress?

According to Mahnke (1996) and on-line health and safety manual (without year), the effects of stress on individuals can be as follows:

- Emotionally: anxiety, panic, anger, frustration, moodiness, irritability, loss of pleasure and interest, despair, depression and impaired sleep.

- Physically: physical effects may include a weakened immune system, raised blood pressure, heart disease, tenseness, tiredness, appetite disturbance, nausea, light-headedness and the emergence or exacerbation of symptoms in any system in the body.
- Mentally: impairment of perception, concentration, memory, judgment, decisiveness, accuracy, motivation and creativity.

Scientific research during the last decade has proved the link between poor environments, or psychologically inappropriate physical environments, and symptoms of poor health such as anxiety, depression, high blood pressure, sleeplessness and an increased need for analgesic drugs (Dilani, 2001)

2.2.4.3 Possible Sources of Stress in the Physical Environment

"An accumulating body of research suggests that the physical environment influence the health and individual stress values" (Danielsson, 2005). The following can be sources of stress arising in the physical environment:

- Excessive noise, noise is not just any sound: it is unwanted sound.
- Poor lighting.
- Poor temperature.
- Poor ventilation
- Exposure to fumes, chemicals, or other unpleasant substances
- Poor workstation
- Poor equipment
- Poor access to natural elements outdoors such as daylight.

Relating to all of the above sources, there is a feeling of control in order to adjust the elements and condition of the physical environments. That is an important factor in affecting stress levels and health conditions. People who do not have control over their environments often suffer from various kinds of stresses (Dilani, 2001).

Lack of affectivity in work environments could be caused by different causes of crowding. In the setting of the workplace overcrowding plays a significant part for the well-being, anxiety, nervousness, higher levels of blood pressure and pulse rate, and result in more errors and control difficulties, which increases the problems of focusing on task-relevant information in the environment.

2.2.5 The Patient and the Interaction with the Environment

2.2.5.1 The Medical Cultural Circle

"A visit to the physician or dentist traumatizes many people. The basis for the fear, even more than lack of familiarity with the procedures and a feeling of helplessness" (Malkin, 2002 p. 1).

It is known that fear and insecurity are always present at the entrance to a new cultural circle. Building on that fact, the medical culture is a new cultural circle, which is unfamiliar to the healthy. For example, the understandable breach of the patient personal space and boundaries in serious diagnosis consultations, combined with the presence of unfamiliar persons such as neighbors, leave no chance of creating a comfortable space for themselves, and instead, creates fear and anxiety. With this, the patient is faced with a lack of respect as the doctor rather

unenthusiastically says: "So, what have we got today?", that seems from other cultures highly inappropriate. To add to this unpleasant experience for the patient, the low level of information flow is also a problem: why what and how something happened for the not so confident patient is quite an overwhelming thing to explain sometimes, and getting an explanation from doctors can be often rather unclear, simply due to the sheer amount of technical information (Miller & Swensson, 1995).

During a medical or dental examination, a person is most susceptible, both psychologically and physically. One's territorial limits are invaded by unfamiliar person who pokes, probes, and prods. Moreover, when the diagnosing process requires that the patient be naked, clad only in a gown, even the barrier of clothing ceases to protect. Is it any wonder, that such incidents makes even the most solid person shake from deep inside whenever a visit is required to a medical service provider (Malkin, 2002) (Monz & Monz, 2001). Additionally culture shock occurs in the small yet busy activity areas, and its narrowness makes the ability to make a decision in this area very difficult, when that patient or one of his or her family has to make a decisions relating to his or her health (Monz & Monz, 2001)

In hospitals there's disorientation long corridors with their many doors with small numbers and names. Sometimes there'll be an arrow, or an information sign for the "Orthopedic Ambulance". Long stretches of hallway where you mightn't meet another person, then some installed beds with patients lying waiting is certainly not the optimal method of greeting new patients! (Monz & Monz, 2001)

Luckily, the ambulatory patient is perhaps less affected than those confined to their beds for he/she can have a change of scenery. The sick person, however, is a captive in a strange and vaguely hostile world where he is stripped of power over himself, his accustomed and comfortable routines, and reassuring personal surroundings. In which case, the reassurance of nurses and physicians can be dangerously undermined if the patient's surroundings in a hospital do not add reinforce to it. If his surroundings are in appearance, dreary, and not altogether

clean, his anxieties may increase. All this can of course delay the recovery. It does not require a graduate psychologist to recognize that his recovery is not likely to be hastened (Sisson, 1978).

2.2.5.2 Patient Psychology

Monz and Monz clearly show the state of a worrying patient:

“The patients are waiting with anxiety and fear of what’s to come, the examination or the consultation which follows. They wait on the edge of their seats, with hardly a word exchanged with the other people in the waiting room.” (Monz & Monz, 2001 p. 10).

Sometimes the patient feels out of reality, but emotionally unprepared also. He/She readily rids themselves of their own previous identity, e.g., student, teacher, director, etc. He just seems to adapt to the given hierarchy, becoming more dependent on help. He has a powerless feeling that he can’t affect anything here- that he’s not at all brave or dignified, but cowardly, powerless. Alone and afraid, he brings all of these feelings mentioned into this new medical world (Monz & Monz, 2001).

Lader (1972) (cited in Fontaine, 1980) has combined the elements of external stimulation and internal determinants to develop an eclectic model for emotional stress outlined in Figure 6.

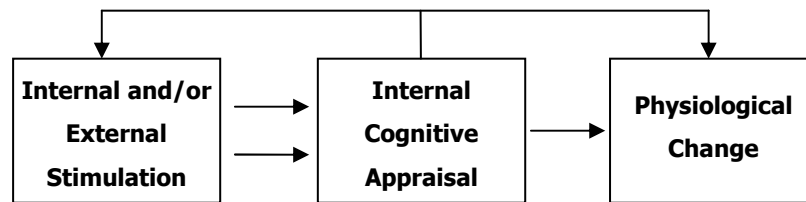


Figure 6: Lader's model of emotional stress.

(from Fontaine, 1980 p. 21).

There is a definite relationship between the emotional state and bodily changes for example “afraid and tremble”, therefore different emotions will give rise to unique sets of bodily states. In the case of patient situation the manipulation of such bodily states by drugs or surgery directly influence the emotional state (Fontaine, 1980).

In conclude it is evident that taking into consideration the vast number of stress triggering factors that the patient is subjected to, minimal interest, has been given by the healthcare administrators to solve/lessen such negative factors. To that Ulrich states:

“In spite of the major stress caused by illness and traumatizing hospital experiences, comparatively little emphasis has been given to creating surroundings that calm patients, strengthen their coping resources, or otherwise address psychological and social needs”
(Ulrich, 2001 p.49)

Chapter 3

Case Studies and Methodology

3.1 Case Studies

3.1.1 Introduction

In the case studies, the aim is striving for an in-depth understanding of the phenomenon. It involves the collection of data using the methods that are discussed in the second section of this chapter, the data analysis and their results are presented in Chapter 4.

If an architectural firm were to propose research about natural light for a particular project. This would not be an environmental/design research as it is defined here. Although the efforts might include site visits to similar projects to expand the firm knowledge base, its purpose is to apply not generate knowledge. On the other hand, if it was proposed that natural light, with its variable quality and implied connection to the outdoors, could improve productivity and job satisfaction. Then the research to test this hypothesis, and to develop its formal implications, could be considered as an environmental/design research (Villicco & Brill, 1981).

Therefore, and in this sense, the case studies in this research involved purposive sampling from various medical specializations and types, as medical offices, medical centers, and outpatient departments in hospitals. In additions to perform the case studies in Egypt as a habitat country of the researcher and also in Germany, where the research has been registered to attain the Ph.D. degree. That allowing to identify cross-cultural similarities and differences. Yet, the assumption is that the natural surrounding in which the problem occurs is the best place to study the problem. Sampling procedures in survey research usually focus on different procedures for selecting random samples (Weller 2000).

Dilani (1999) mentioned the main principles of a case study with reference to Lundequist (1994):

- The case study method is the preferred strategy when more than one source is being used and when the researcher has little or no control over the course of events.
- The case study should be focused on contemporary phenomena in its actual environment. The relationship between the object being studied and its context is important.
- As the main issue of a case study often deals with the interaction between factors in the context and factors that are the focus of the study, the research work can often become very time-consuming. For this reason the number of cases should be limited.
- The case study methodology may be explorative, descriptive, or explanatory.
- One distinguishes between single and multiple case studies and between single units analyses and multiple unit analyses. Different methods for the collection and analysis of data are linked to these strategies.

3.1.2 Case studies in Egypt

“The issue of ownership is complex in all research. Does the videotaped data belong to the subject/object of the video or to the researcher? When people agree to

videotape their life story for a specific reason, do they give permission to researchers to scrutinize their every word? (Rosenstein, 2002). The aspect of observation, as the main method used in the case studies, was a point of dispute, as recent occurrences of immoral use of photography and video footage of patients was a hot topic of debate. For the case studies in Egypt, it was planned to perform a case study in the offices of various medical disciplines. First, contact with many different doctors was established. Through this contact the research concept was explained to them, the goals of the research and also the procedures of the case study and that the case study is to include observation. Here a problem was incurred. Video recording and photographic in private medical offices was a hot discussion theme among the medical administrative, patients, and law specialists. That on the background of previous abuse of video data and photos from some doctors in private medical offices. Therefore, it was not possible to perform case studies in Egypt in private medical offices.

The other choice available, was to approach administrative contacts within the state owned medical centers and hospitals. After explaining our circumstances, a special dispensation was granted to us, to use the information only for research purposes, and that all given information was not to refer to any names or names of institutions.

In light of these discussions the carrying out of the case study was only then able to begin, and with an admittedly shortened time span.




























As mentioned above, the idea was to carry out the case studies in four main medical disciplines, and also in urban and rural places (city; towns; and villages). The overall aim of the study was to determine work processes and different cultural contexts.

Due to the short time span, the number of patients' questionnaires completed fell short of our expectations. Though, the number of medical staff 's questionnaires and interviews were up to our expectations. Some of the scientific tools were not yet



available, and because of limited time, it was not possible to measure the average levels of brightness and room temperature.

Regarding the case studies performed in Egypt, Table 1 summarizes where the different areas the case studies performed, the medical disciplines it was carried out in, the number of patients who took part in the questionnaire, and questionnaires given to medical staff and the interviews that followed, and which rooms the observation was performed in.

Table 1: Case study in Egypt

		Medical centres						Hospitals							
		City			Town		village	Hosp. A					Hosp. B		
		GP	Pediatric	Dental	Pediatric	Dental	Pediatric	Dental	GP	Dental	ENT	Ophthalmologic	Orthopaedic	GP	Dental
Questionnaires with patients (n)		2		7	3	6	1	1	2	2	3		1	1	3
Quest. & interview with staff (n)		5		5	5	4	1	4	5	3	2	2	3	2	6
Observation	Exam. 1														
	Exam. 2														
	Waiting														

Notes:

- n: the number of patients or staff member included in the interviews and questionnaires
- : indirect observation using video camcorder
- : direct observation using pens and papers to sketch the remarks (without using video camcorder)
- ENT: Ear, Nose, and Throat.
- GP: General Practice.

3.1.3 Case Studies in Germany

On the other side, regarding the case studies in Germany, it has been achieved as planned to perform the case studies in various medical disciplines in private medical offices, as well as in the out-patients departments in hospitals. First, contact with many different doctors and administrative personal was established. After the explanation of the research goals and the procedures of the case studies, few doctors in private medical offices and administrative doctors in the hospital of the university of Duisburg-Essen, agreed to include observation processes and contacts with the staff and patients in the case studies. Higher numbers of patient's questionnaires have been established, that because of the extra time span in comparison with the studies in Egypt.

Questionnaires and interviews with the medical staff have been established. In addition, measurements of the average levels of brightness and room temperature were performed.

Regarding the case studies of Germany, Table 2 summarizes the different areas where the case studies were performed, the medical disciplines it was carried out in, the number of patients who took part in the questionnaire, and questionnaires given to medical staff and the interviews that followed, and which rooms the observation was performed in.

Table 2: Case study in Germany

		Practices						Uni. Hosp. Essen				
		General			Specialized			Pediatric			Surgery	
		Practice A	Practice B	Practice C	Pediatric	Dental	ENT	General	EEG	Ergo therapy	A&E	Neurological
Questionnaires with patient (n)		20	22	22	21	20	22	20	21	0	0	15
Quest. & interview with staff (n)		4	3	3	4	3	5	1	4	2	3	2
Observation	Exam. 1											
	Exam. 2											
	Exam. 3											
	Lab.											
	Reception											
	Waiting											
Measurement												
		/1\	/1\	/1\	/1\	/1\	/1\	/1\	/1\	/1\	/1\	/1\

Notes:

- n: the number of patients or staff member included in the interviews and questionnaires.
- : indirect observation using video camcorder.
- : direct observation using pens and papers to sketch the remarks (without using video camcorder).
- : temperature measurements (in °C units).
- : illumination measurements (in Lux units).
- A&E: Accident and Emergency Surgery.

3.2 Methodology Overview

3.2.1 Introduction: The Research Strategy

A concise research strategy definition is the cornerstone for deciding about the research methodology to be adopted. A methodology is a general approach to studying a research theme, as it establishes the manner in which to study the phenomenon (Silverman, 1993). A research methodology is the procedural framework in which the research is conducted. There are many drivers and factors to be considered when choosing an appropriate research methodology, with the topic to be researched and the specific research question being primary drivers (Amaratunga *et al.*, 2002).

Figure 7 illustrates the research strategy to be followed in this dissertation. The present research strategy relies not only on reviewing past considerations and related works on the theme (whether the latter conceptualizations and works are in written or verbal form), but also on an extensive empirical part to explore the fieldwork. This should enable us better to understand things from within, to procure experience, and thus to build up a holistic perception of the matter. This is due to the statement implying that environmental design research must be experimental in its methodological aspects (Villeco & Brill, 1981). Here, the assumption is that the natural surroundings in which a problem occurs is the best place in which to study the problem. Thus, this research endeavors to bridge the gap between practice and research (Schulze, 2003).

According to Patton (1990), the involvement in fieldwork and obtainment of experience permits access to personal knowledge which will, in turn, aid in an in-depth understanding and a better interpretation of the field being studied.

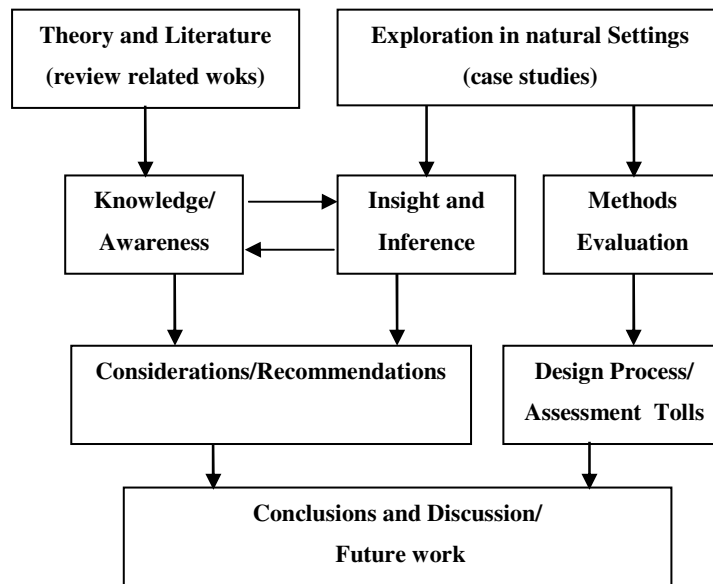


Figure 7: The research strategy

The theoretical basis and related aspects of the study were classified and reviewed in Chapter 2. They underpin the approach adopted to various other aspects considered throughout this thesis. In this chapter, the methods used to carry out the empirical exploration of the fieldwork (several and different medical environments) will be presented and discussed. The research problem and data available determine the choice of the method (Schulze, 2003).

In some cases, the methods and criteria for research are, themselves, the topic of research; so too are inquiries into the nature of the design process or the development of intervention strategies on behalf of innovation (Villeco & Brill, 1981). In this sense, one of the research goals was to evaluate the effectiveness and possible usage of methods employed during the empirical part of the study. The aim is to suggest which methods could be used and in which way they

should be applied in the design planning process of medical environments. The methods presently available are discussed in the following in depth.

3.2.2 Quantitative and Qualitative Methodologies:

A Mixed Approach

Several methods may be used in approaching a problem, and they often have different values and assumptions. Methodologies, however, may be categorized into two distinct types: qualitative and quantitative. One important way to strengthen a study design is through a combination of these methodologies in the study of the same phenomena. This might imply the usage of several methods and/or data, while employing both the quantitative and qualitative approaches (Patton, 1990).

The quantitative approach is a branch of thought which tries to find out the origins and justifications of a specific attitude. It is concerned with frequency and quantities, to measure “how much” and/or “how often”. In terms of comparative analysis and statistical analysis, this approach allows flexibility in the treatment of data (Amaratunga *et al.*, 2002). Critics of quantitative studies observe that these studies restrict our view of human beings because they concentrate solely on repetitive and predictable aspects of human behavior. In their view, qualitative methodology can overcome these shortcomings (Schulze, 2003).

In contrast to quantitative research, the qualitative approach concentrates on people's behaviors, in prosaic situations, to describe their own reality and practice. It is concerned with “words” and “observation to express reality”, as well as “attempts to describe people in natural contexts”. This type of research requires the researcher to undergo intense contact with a “field” or life situation (Amaratunga *et al.*, 2002). Yet, while qualitative inquiry provides the researcher with an in-depth knowledge, this is usually not generalizable. It is more useful for exploring phenomena in specific contexts, articulating participants' unique understandings and perceptions

and generating tentative concepts that directly pertain to their environments. Thus, policies and decisions based on qualitative information tend to be more directly suited to the specifics of the milieu from which they are derived (Schulze, 2003).

Figure 8 illustrates in a sense the distinctive characters of qualitative and quantitative methods. The bridging of both approaches is necessary for accomplishment.

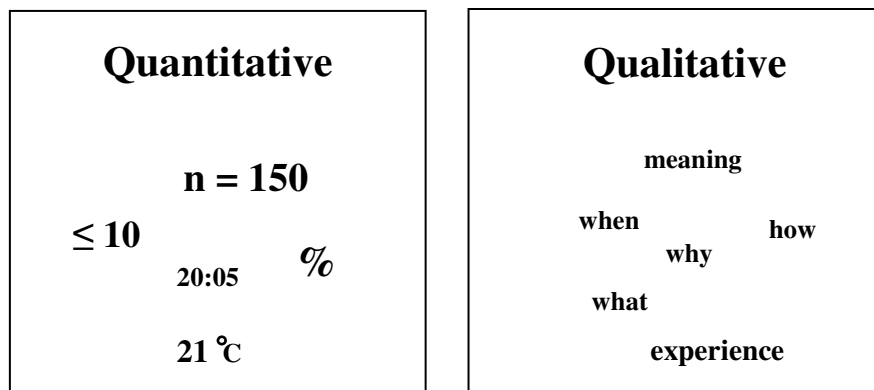


Figure 8: Character of quantitative and qualitative methods.

Methodologies can be neither true nor false; they may only be more or less applicable and useful (Silverman, 1993). The advantage of a quantitative approach is that it is possible to measure the reaction of many people to a limited set of questions, thus facilitating comparison and statistical aggregation of the data. This in return provides a broad, generalizable set of findings that may be presented succinctly and parsimoniously. By contrast, qualitative methods typically produce a wealth of detailed information about a much smaller number of people and cases. This increases understanding of the cases and situations studied but reduce generalizability (Patton, 1990).

By combining quantitative and qualitative research methods, researchers can simultaneously conform to and transcend dominant research conventions, making use of the most valuable feature of each (Schulze, 2003). Thus, there is a growing suggestion within the research community that research, both quantitative and qualitative, is best thought of as complementary and should therefore be mixed when carrying out different kinds of researches (Amaratunga *et al.*, 2002).

Patton (1990: p.14) comments on the use of both qualitative and quantitative methods as follows:

“Because qualitative and quantitative methods involve differing strengths and weaknesses, they constitute alternative, but not mutually exclusive, strategies for research. Both qualitative and quantitative data can be collected in the same study.”

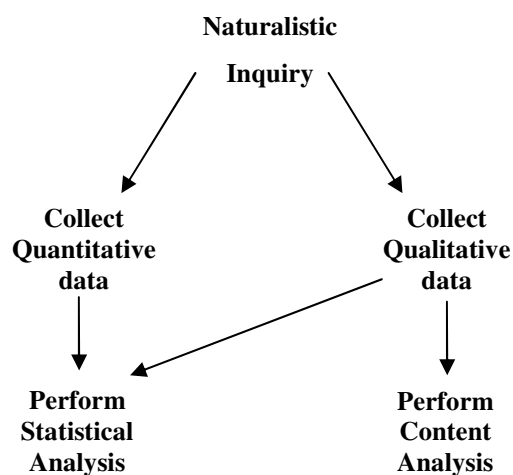


Figure 9: Mixed approach of using methods.

(Adapted from Patton, 1990: p195).

Actually, it is worth mentioning that qualitative research can use a wide range of quantitative analyses, starting from simple frequency tables and extending to multivariate statistical techniques (Thomas & Nelson, 1990). for example, observation provides mainly qualitative data on human behavior, which may be supplemented with quantitative facts through keeping tally of the number of times a particular behavior occurs, or by recording a specific behavior at set time intervals (Schulze, 2003).

3.2.3 Criteria for Selecting and Employing the Methods

Methods are the specific techniques that are used to investigate the phenomenon. These include techniques like observation, questionnaires, interviewing, and measurement. Once again, techniques, themselves, cannot be considered as true or false. They are more or less applicable and useful, depending on the situation that requires investigation. The following criteria will be used to select and employ the methods:

1. **Validity in terms of results:** the method to be used must relate practically to the foreseen results.
2. **Validity in terms of environment:** the methods to be used should be suitable to the environment and/or practice to be investigated.
3. **Validity in relation with the side effect:** the methods to be used should have minimal side effects on the working environment, and possible side effects should be known.
4. **Validity in relation to manpower requirements:** it should be possible to implement the method to be used, with manpower that is already available.

The result: the judgment of the importance of the used methods should explain the meaning of their results to the whole study. Predictive validity refers to the usefulness and efficiency of a specific method in obtaining results and the evaluation of the used method in this respect is one of the central aims of the present investigation (Annett, 2002). If methods supply secondary results, rather than information pertaining to the main study question, it should be ignored. The cost of using any method may only be justified if the results garnered are potentially necessary.

The environment: logically, a thorough knowledge of methods used previously can supply us with a basic indication of their potential and which of them are acceptable to the environment under study. Environments that serve special populations may also involve natural limitations on the choice and use of methods to be adopted. Also, related personnel may reject additional burdens, such as having to include an evaluator in a program where resources are limited. Yet, where staff-client ratios are important, as is true of many medical environments, there is a risk of unbalancing the situation by the addition of a investigator (Patton, 1990).

The side effect: the question of how great influence the usage of a method on the investigated environment is an important one, an ideal situation is that the method has little or no influence on the work environment. Often, however, the use of a method in a working environment may create an unreal or affected situation, thus, the environment to be studied may be altered or in worst case scenarios, destroyed. This can also be caused by the mere presence of a measurement system, or through the physiological disposition of the observers. The most naturalistic field studies are reports of what goes on when a visitor is present. The important question is, how important and limiting is this process? There are various ways of suppressing reactivity. Typically, these include the visitor staying in the observed setting for a

period of time long enough for s/he no longer to be considered an 'intruder'; and, in all possible ways (e.g., dress and location in a room), for the visitor to seem as unobtrusive as possible (Thomas & Nelson, 1990).

Clearly, presence of an observer can lead people to engage in behaviour additional to their normal activity (Stanton *et al.*, 2005). An external observer is present and occupying space in the field of observation. This almost always has some influence on the field of observation. Indeed, this can happen for very practical reasons: bottlenecks, for example, may be created in reception due to the space occupied by the observer. Also, the normal operation, interaction, and relation between practice personnel and doctors may be influenced by the simple presence of an observer or camera. Such instances not only result in deliberate, but also unintended reactions to the feeling of being observed.

The manpower: it is the consideration of the costs associated in relation to the relatively limited personal resources. The researcher would execute the investigation procedures. Thus, on one hand, this requires more time for the investigation, and on the other, limits the extent of the application of the employed method.

3.3 Selection and Description of Methods

Studies that use only one method are more vulnerable to deficiencies linked to that particular method than studies that use multiple methods, in which different types of data provide cross-data validity checks (Patton, 1990). In this sense, there is growing tendency to utilize and focus on “triangulation”. Triangulation is the combination of methods in the study of a phenomenon (Amaratunga *et al.*, 2002). Divergent results from multi-method approaches can lead to an enriched explanation of the research problem and question (Jick, 1983).

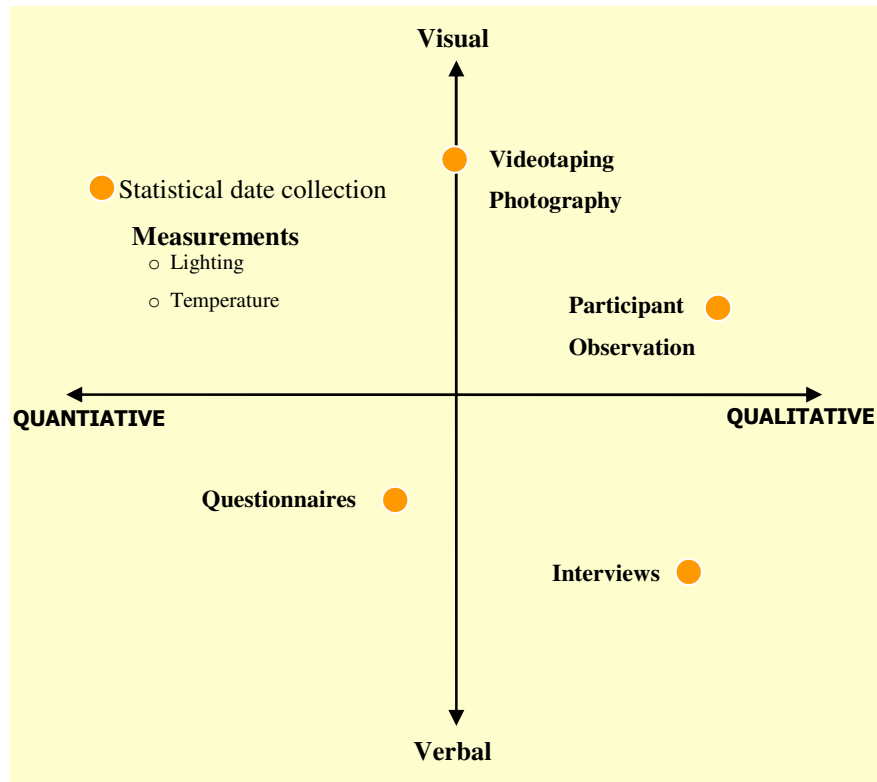


Figure 10: The combination of methods.

(Adapted from Plowman, 2003 p. 30).

- The observation yields mainly qualitative data, especially in case of video and photo recordings, which can be supplemented with quantitative information (Schulze, 2003).
- The interview is undoubtedly the most common source of data in qualitative studies. The person-to-person format is most prevalent (Thomas & Nelson, 1990 p326).
- The questionnaire is the basis for collecting the information and elicits responses to quantitative data.
- The measurement is one of the most standard tools in the quantitative methodology, which provides objective measures.

3.3.1 Observation

Verbal testimony must remain the major source of data. There are limitations, however, with regard to how much can be learned from what people actually say; likewise, how far can they express their needs and vocalize their feelings. In order to understand fully the complexities of many situation, direct participation in and observation of the phenomenon of interest may be the best research method (Patton, 1990). The various methods of observation can provide serendipitous discovery opportunities. That is to say, the methods may lead the investigator to explore portions of the problem domain where information that is useful may be encountered even though it was not anticipated (Nemeth, 2004).

There are many and varied observational techniques, which fall into three broad categories: direct, indirect, and participant observation:

- **Participant** would be representative of end users of the system being analyzed, but it is not always possible for the observer to perform the actual task or work under consideration (Stanton *et al.*, 2005).
- **Direct observation** is where the investigator is actually present during the task, but once again, however, it should be noted that the presence of an observer can lead to the development of unreal situations which, in turn, have a bearing on the performance of tasks. During direct observation the simplest tools are pen and paper; these can be supported with photographic evidence.
- **Indirect observation** is where the task is viewed by some other means, such as the use of a video recorder. Some tools of observation require human intervention. Ideally, observational tools will be useful not only for observation but also for intervention (Intille *et al.*, 2003). One could attempt to observe behavior covertly, i.e., by using hidden cameras. However, this raises the underlying matter of ethical conduct in observations (Stanton *et al.*, 2005). Therefore, using video cameras during indirect observation can be conducted after obtaining prior agreements from the people involved. The video data can be analyzed later in the laboratory.

The visual medium is considered a relatively exact tool of ensuring data accuracy. Visual tools, such as video and photography, are used to gather, discover, and/or elicit data for analysis. They improve analysis objectivity (EL Guindi, 2000)

3.3.1.1 Using Video

Videos of observed interactions can be of particular value when complex activities are being observed, and especially where it proves difficult for an observer to record all events in real time. One solution to this problem is to use more than one observer and for each observer to have different responsibilities. However, due to the additional disruption caused by having more than one observer (Tools & Techniques, Direct Observation, without year), this is not recommended for use in home or work settings. In direct observation by an observer and during an intensive period full of events, the scribe's working memory gets quickly filled with detailed data that the observer tries to write down, and he cannot afford cognitive resources on high-level processing of the data. If the observer tried, then this would cause the missing of much of the objective events and actions (Laakso & Laakso, without year).

Rosenstein (2002) points out that people, including children of all ages, respond to the presence of the camera very much as they would to the presence of an observer. Their behavior is self-conscious for approximately twenty minutes and then the observer or the camera fades into the background. Thus, after twenty minutes, the recorded behavior is an accurate representative account. Yet it is not entirely true that the presence of a camera or an observer are equally distracting, because the space occupied by the observer can cause more oversight, and bottlenecks. Whereas the video cameras can be hidden out of sight and physical reach of people being observed. Even when people know that they are being observed, it is still a fact that the time required by for fading into the background remains shorter when using a video camera. Additionally, at the present time, camcorders (digital video

cameras) are small, lightweight, as well as capable of obtaining remarkably clear pictures in natural lighting, and they take the minimum possible attention of people.

Rosenstein (2002). comments on the videotaped record:

“although selective in the positioning of the camera and the breadth of the lens, still records all that is within its view. Such an inclusive record can then be analyzed by multiple viewers” Rosenstein (2002, p. 7).

Video-recording equipment is of tremendous value in observational studies. Because the activity of interest can be videotaped, observers can be sure that their recording techniques and data can be viewed more than once. (Thomas & Nelson, 1990). One helpful method employed is to log the recorded data using time codes, using a similar category systems to those used with other kinds of data analysis. Recent advances in computer compatibility have made computer programs a viable method of selecting, itemizing, and storing video data (Rosenstein, 2002).

3.3.1.2 Photography

The main advantage of photography is that it allows the observer to document the current state of the environment. Also, using photography supports the notes of the observer, who normally may only capture a fleeting moment with notes, sketches, and memory. Photography captures the details, and typical and individual work situations which latter may be used in carrying out discussions.

Photography can provide much greater accuracy and much more information about complex, brief events than visual observation with written notes. Photographic data are often surprisingly rich in information. Finally, photography often permits the gathering of data less obtrusively and less expensively than other means (Davis & Ayers, 1975).

3.3.2 Interview

The interview is a method for discovering facts and opinions held by potential users of the system or the environment. The interview is one of the original methods for gathering general information, and it has been popularly applied across a range of fields. Interviews can yield results in any situation where a person's opinion or perspective is sought (Young & Stanton, 2005). Direct quotations through interviews are a basic source of raw data in qualitative inquiry, revealing respondents, depth of emotion, the way they have organized their world, their thoughts about what is happening, their experience, and their basic perceptions (Patton, 1990).

Researchers agree that the flexibility of the interview is also a great asset. That is to say, if desired, a particular line of inquiry can be pursued. The main advantage of the interview is its familiarity to the respondent as a technique. This, combined with the face-to-face nature, is likely to elicit more information, and probably more accurate information (Young & Stanton, 2005).

According to Nemeth (2004) the interviewing types, which are of interest to the social scientist, are categorized into six types. Three of these are particularly helpful in human factors research, which are:

- **Casual/conversational interviewing**
- **Open-ended interviewing**
- **Interviewing that includes formal eliciting techniques**

Table 3: Different formats of interview along with their advantages and drawbacks.

(from Nemeth, 2004).

Type/form	Data reduction	Advantages	Drawbacks
Causal	Depending on length, can require extensive analysis	Inexpensive, flexible	Can be inconsistent if administered by more than one interviewer; may not have the benefit of notes and other records that the later reference
Intercept	Efficient	Respondent can offer opinions, ask questions, and explain answers	Limited in depth
Long interview	Can require extensive analysis	Can discover otherwise unknown attitudes and motivations	Can take significant amount of time to summarize, interpret
Focus group	Significant cost and time to prepare and analyze	Can collect attitude, preference and qualitative data; well suited to obtaining reactions and comparative preferences	Can require substantial sample development and recruiting
Phone	Efficient	Rapport more direct than self-report methods	Limited opportunity to ask clarifying questions or to open new lines of inquiry; limited in depth

Actually, the interview is undoubtedly the most common source of data in qualitative studies. The person-to-person format is most prevalent and it has the highest participation rates (Thomas & Nelson, 1990) (Weller, 2000). Interviewing includes any situation in which a fieldworker (researcher or designer) seeks information by asking for it, however casually. This deliberate choice to seek information separates interviewing from observation. In the simple act of asking, the fieldworker makes a 180-degree shift from observer to interlocutor... In the first case, one takes what one is offered; in the second, one makes personal preferences known (Nemeth, 2004).

Interviews use the strength of interpersonal interaction in order to build a base of knowledge. The interviewer can probe further to understand the answers a subject gives, can observe the subject and ask questions in response to non-verbal signals, can observe the context (e.g., room) in which the subject answers the questions and can encourage the subject to be forthcoming (Nemeth, 2004). The interviewer creates a structure for the transaction through his/her choice of particular information to sought, the creation and ordering of the questions, and the pursuit of a particular line of questioning (Nemeth, 2004).

Observations of a user trial can be used in conjunction with the post trial interview output to corroborate (or otherwise) the benefits and problems with the product's design. Whereas the interviews reveal subjective opinion and perception of product usability, observations demonstrate actual device errors and performance time (Young & Stanton, 2005). This thesis adopts the approach that, in the context of environmental design, the most useful way to conduct an interview is *first to watch* the subject in action, and then to proceed to an interview with the subject. By letting one's interaction with the subject be guided by the notes and perspectives built up during the observation, the interview may be rendered a convenient, efficient way to gather data.

3.3.3 Questionnaire

Written questionnaires can be carried out without the presence of the investigator. According to Nemeth (2004) there are four reasons why questionnaires are beneficial, ease of use, facility as a tool to collect quantitative data, relatively low cost, and the potential to collect information from many respondents in separate locations or organizations. The questionnaire is often the only practical way to gather factual information from members of a large and separate population.

Nemeth (2004) points out that questionnaires have a low response rate compared to interviews. How individuals respond to questionnaires might result in biases (from causes such as unanswered questions and selective responses). In contrast to interviews, questionnaires offer no ability to ask follow-up questions and no opportunity to open a new line of inquiry. The subject might interpret (or misinterpret) the questions and provide answers according to his/her own needs and interests, rather than those of the investigator.

The biggest weaknesses in questionnaire design occur when an investigator drafts a set of questions without having sufficient background. The results are often a set of poorly worded questions with unclear response categories (Weller, 2000). Nemeth (2004) adds also that the questionnaire can be negatively affected by the responders mood, degree of attention, and interpretation of questions.

In general, questions should proceed from broad general requests for information to more specific requests of detailed information. This is to avoid the former type of questions from biasing the latter. Similarly, less personal questions should precede those perceived as more private or threatening (Weller, 2000).

The best format for a question or series of questions depends on the type of information desired. Weller (2000) mentions three types of Questions:

- **Open-ended**
- **Close-ended multiple choice**
- **Rating scales**

Open-ended questions should be simple and seek clear, short answers. For example, “How many times have you been to the hospital this year?”. Questions such as “How do you like your job?”, which allows considerable latitude to the respondent to express feelings and to expand on ideas, are also encouraged (Thomas & Nelson, 1990).

Close-ended questions should be concise, and backed up with a complete listing of mutually exclusive response categories (Weller, 2000). Close-ended questions come in a variety of forms; a few of the more commonly used are rankings, scaled items, and categorical responses (Thomas & Nelson, 1990).

Scaled items are one of the most commonly used types of closed questions. Subjects are asked to indicate the strength of their agreement or disagreement, or their impression or evaluation with some statement or to cite the relative frequency of some behavior (Thomas & Nelson, 1990).

Rating scaled questions are usually appropriate only for literate informants with a moderate degree education (Weller, 2000).

Table 4: Different formats of interview along with their advantages and drawbacks.

(from Nemeth, 2004).

Methods/purpose	Advantages	Drawbacks
Rating scale-Collect easily quantifiable data from many subjects.	Can be answered quickly. Data reliable and amendable to summary statistics.	Little room for unanticipated answers. Questions must be well thought.
Hierarchical-Combine several types of questionnaires and levels of data.	Answers are detailed and specific. Speeds time to complete. Only important questions are asked.	Requires time and familiarity with content in order to prepare.
Semantic differential-Measure values, attitudes, or complex relationships.	Provides data on relative similarity of attributes. Easy to prepare and administer.	Correct analysis and interpretation requires experience.
Multiple choice-Screen respondents, collect demographic data.	Answers easy to summarize.	Questions must be simple and may force choice.
Open-ended-Collect information from small samples of qualified subjects.	Easy to write. May discover unanticipated information.	Difficult to summarize. Require more time to answer.

Questionnaires can take many forms, but they can be considered as an extreme form of a structured interview. Indeed that is true, as a formal structured interview is essentially just an administered questionnaire. The obvious advantage of a questionnaire is that it can be completed on paper by the participant, thus enabling huge samples of data collection with relatively minimal effort on the part of the experimenter (Young & Stanton, 2005).

3.3.4 Measurement

Assessing the physical environment can be a complex task. Decisions have to be made about what variables to measure, where and when to take measurements, what instruments to use and how to use them (Hedge, a2005).

This section considers two variables; the thermal and the visual conditions. These variables are considered because they are expected to be the most relevant variables in the medical environment. Problem related to other variables such as noise and vibration, which are consequences of the medical devices, are at present almost solved with the new technologies adopted.

In addition to the measurement methods presented here, which are objective methods, there are subjective assessment methods. The subjective assessment methods have been developed with scales to be used in questionnaires and surveys, and their categories with the related questions are as follows:

Perceptual:	How are feeling about ...?
Evaluation:	Do you find this...?
Preference:	Would you like/prefer to...?
Acceptability:	Do you find this acceptable?
Tolerance:	Is it tolerable?

(adapted from Havenith, 2005, Rea & Boyce 2005, and Boyce 2005)

3.3.4.1 Thermal Conditions Measurement

Measurement of the thermal environment is more complicated than simply quantifying air temperature (Hedge, a2005). Environmental temperature measurements should be made as close as possible to the specific work area to which the persons are exposed. When a person is not continuously exposed to a single area but rather moves between two or more areas having different levels of environmental temperature, or when the environmental temperature varies substantially at a specific area, environmental temperature should be measured for each area and for each variant in a single area (Hedge, b2005).

As temperature increases, a decrease occurs in the body heat loss through convection, conduction, and radiation . According to Havenith (2005) the overall effect of temperature can be assessed by measuring the following three relevant properties:

- **Air temperature**
- **Mean radiant temperature**
- **Surface temperature**

Air temperature can be measured by a conventional alcohol-filled thermometer or by an electronic thermometer. Smaller sensors react faster to variations in the climate. The measurement workstation is defined before carrying out the actual measurement. Sensor range/accuracy: to measure comfort: 10 to 40°C/±0.5°C.

Mean radiant temperature is the mean temperature of all walls and objects in the space. Mean radiant temperature is most commonly measured indirectly using a matte black globe (typically 15 cm in diameter) with a temperature sensor in its centre. Given the size of the globe, it needs a long period to equilibrate (>20 min), and is therefore not sensitive to fast fluctuations in radiation.

Surface temperature is measured with special sensors that ensure a good contact with the surface while insulating the sensor from the environment, or with a noncontact infrared sensor. With a contact sensor, the conduction between surface and sensor must be much higher than that from the sensor to the environment, and sometimes conductive paste helps. However, surface with very low conductivity (e.g. wood, styrofoam) may yield false values, and in such cases a noncontact infrared sensor is better.

In addition to the temperature measurements there are many standardized testing methods for indoor air gases, vapors, and inorganic particulates. Rather than attempting to select a handful of these, attention has been focused on conducting an indoor air quality investigation of the workplace, as well as choosing the type of instruments and sampling methods deployed (Hedge, a2005).

3.3.4.2 Illuminance Conditions Measurement

According to Boyce (2005), one of the methods of the lighting survey is a reading test that uses sentences printed in 10-, 8-, 6-, and 4-point print. All people have to do is to indicate the smallest print they can read. This test is based on findings that state that printing of twice the size of the threshold visual acuity will be easily read. For good-quality lighting, 95% of occupants should be able to read 6-point print or larger.

Other methods deployed include the usage of an Illuminance meter (lux meter), which should be cosine, colour corrected, and having sufficient sensitivity for the illuminances which are expected to be found in the environment investigated.

3.3.4.2.1 Illuminance measurements

Before starting the measurements in the work environment, failed lamps should be replaced and luminaries should be cleaned, and the workstation's main working area is identified. If there is an automatic switching or dimming system, the state during the measurement should be decided on. Before starting any photometric measurements, lights should be on for at least 20 min. Photometric measurements are taken at a representative sample of workstations. Illuminance on the working surface is measured using a grid of points at 30 cm separation, arranged so as to cover the working area. The average illuminance is calculated and then the ratio of the minimum to the average illuminance for each workstation is calculated. This ratio quantifies the illuminance uniformity for the working area of each workstation. The overall mean illuminance for all the workstations is then calculated from the average illuminance for each workstation. The ratio of the lowest average illuminance for any workstation to the overall mean illuminance for all the

workstations quantifies the illuminance uniformity between workstations (Boyce, 2005).

3.3.4.2.2 Reflection tests

While sitting at the workstation, the investigator places laminated paper on the desk where the occupant would typically place reading material. If a conspicuous, bright image of luminaries or window is apparent in the paper, then veiling reflection are likely to be present when glossy materials are used. If veiling reflections are present, the investigator places the mirror on the location of the reflection, and looks into the mirror. What ever is seen in the mirror will be the source of that veiling reflection. If the workstation has a computer, the investigator turns the computer system on, sits at the workstation as if he/she were using the computer, and looks for a conspicuous, bright image of luminaries or a window on the screen. If this is apparent, the investigator places the mirror on the image and looks into it. Whatever is seen in the mirror will be the source of that image (Boyce, 2005).

Chapter 4

Analysis and Findings

4.1 Introduction

A substantial collection regarding this particular area of environmental design aspects and how they affect users and work processes exists in the current area of related science. Unfortunately, there is also a ‘communication gap’ between these sciences and their applications. The theoretical knowledge of science needs to be put into practice in the real world.

This research presents the case studies that have been performed along with the relevant analyzed results in order to explain particular environmental design aspects and how they affect users and work processes. The qualitative and quantitative data provided by such case studies are crucial to understanding the nature of the problem and in answering the following questions:

- Why are the environments not being used as intended?
- How do the environments affect the social and psychological aspects of all users?
- Which are the culture differences relating to the behaviours and cultural background of the patients and medical staff in Egypt and Germany?

- How accurate are the methods used in the investigation? And furthermore, do they assist in tackling problems and analyzing them?

Table 1 and Table 2 in chapter 3 summarize where the different areas the case studies performed, the medical disciplines it was carried out in, the number of patients who took part in the questionnaire, and questionnaires given to medical staff and the interviews that followed, and which rooms the observation was performed in.

4.2 Nature of medical Work Processes and the Impact of the Context

"The designer is supposed to shape the environment so that certain activities can take place and so that certain human needs are satisfied" (Aas, 1975). In order to accomplish this purpose, the designer must become acquainted with the activities that take place in the related environment, as well as obtain information from the end-users involved in the environment being designed. "Directly querying a user is a powerful technique, but one that should be done sparingly to avoid annoying a user (e.g., perhaps routines)" (Intille *et al.*, 2003).

Medical offices and ambulant units in hospitals are special environments where privacy is highly respected as well as protected, and where the health and confidence of patients is of the utmost importance. Therefore, the opportunity to study medical work processes in such settings is somewhat limited. Despite the limits of the latter, obtaining the permission to carry out direct and indirect observations in those sensitive environments was successful. The data from such observations consisted of detailed descriptions of the user activities, behaviors, actions, and the full range of interpersonal interaction involved (Patton, 1990).

The value of observational data in evaluation research is highly significant; the data enables the evaluators to understand the program activities and its impact. This is made possible through the detailed, descriptive information on several aspects. These are information about what has occurred in an environment and information about how the people in the environment have reacted to what has occurred, (Patton, 1990). The first purpose of analyzing the observations is to understand the setting that was observed, to recognize the work processes involved, and to define the effects of the designed environments on these processes. The second purpose is to transfer the nature of medical work processes and to give the designers the opportunity to consider the opinions of those interviewed, to appreciate the many processes involved, as well as to perceive the broader physical and socio-cultural context in which these processes take place.

Video cameras are ideal for recording the activities as well as the relative elapsed time. Since all the information is visible at one time, observing recorded footage offers a fair and accurate method in rating the activities recorded. More recently, with the arrival of digital camcorders and PC editing software, time study can be executed more efficiently, and thus the study of the different events can be made easier (Niebel & Freivalds, 2003). In the case studies carried out for the purposes of this research, most of the structural observation was recorded, using a digital camcorder. This was carried out in examination and treatment rooms in different facilities of different specializations. The goal was to observe all the work process occurring with one patient (or more) in the examination and treatment rooms. This method made it possible to observe and record in digital capture. Later, all the video involved was transferred to computer. In this way it was possible to analyze them directly on the a computer (Rosenstein, 2002). The video data in every case study have been transferred as time-coded video images by using special editing software.

In describing a typical program to unfamiliar users it is helpful to provide a profile of “typical” cases, which in turn helps choosing those cases which are

particular interesting to this work. These cases are selected with the cooperation of key informants, such as the staff, who can help identifying what is typical. It is also possible to select typical cases from surveying the data (Patton, 19903). Since in most settings it will be impossible to include all the cases that are exemplary of a particular construct, in some instances it will be necessary to sample (and not arbitrarily select) cases that are representative of the construct (Waters, 1980). Medical staff was asked about patients to be considered as examples of typical work processes in the environments to be assessed. After video recording of those typical samples, tasks and activities analysis have been performed using appropriate software which shows the time elapsed.

4.2.1 Task and Activity Analysis

The word task is defined as the work has to be done and activity is the way it is actually done (Decortis *et al.*, without year). Task analysis can be defined as the study of what a user is required to do, in terms of action and/or cognitive process, to achieve a task objective. Task and activity analysis help in collecting information, organizing it, and then using it to make various judgments and design decisions (Kirwan & Ainsworth, 1992). The analysis provides a structure for the description of tasks and activities. This makes it easier to describe how several activities fit together in building a medical work process, as well as in exploring the impact of the designed environments on performing these processes.

Medical work processes differ from one specialization to another. The diversity in the processes is due to:

- clinical specialization;
- medical team number, qualifications, and experience;
- organizational policies and laws regulating the work apportionment in the facility;
- available facilities (devices and place); and
- the cultural context.

All these factors affect the work processes and transforms them from best-case scenarios to individual processes. Figure 11 illustrates this transformation process.

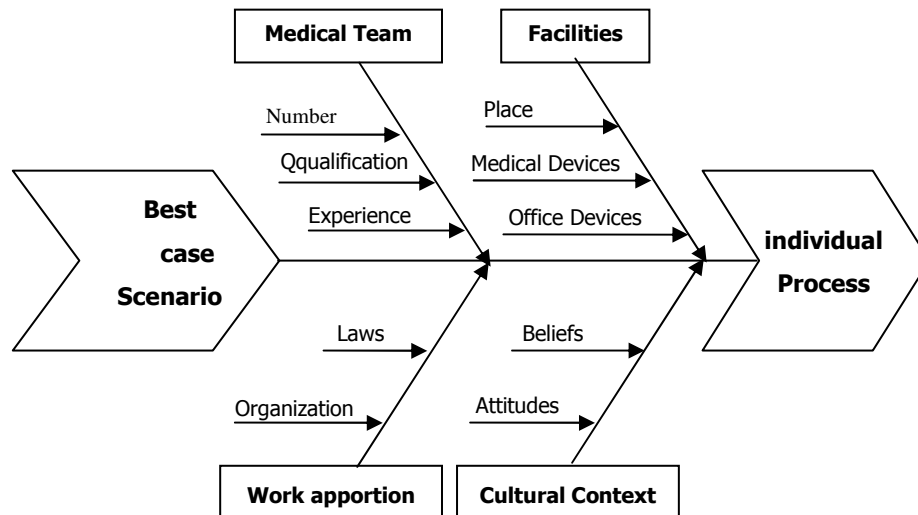


Figure 11: The transformation process from best-case scenario to individual process.

Therefore, in the case studies involved, it was necessary to isolate and execute classification for the main tasks which can be performed in the related medical offices and ambulatory care facilities. After observing different medical processes and carrying out interviews with the medical staff, isolation and classification of tasks were made possible. This shall be explained below:

- C. Patient/Family: communication with patient and family.
- EX./Treat.: examine and/or treatment of patient and administering medicaments
- Pr./Re.: read and register protocols, Patient information, and prescriptions
- C. Staff: communication among the medical staff.
- Assist: assist and cooperate among staff member.
- Arrange: arrange material, tools, place and/or devices.

Figure 12 illustrates the range of possible tasks which can be performed in the different medical work processes (in both medical offices and ambulatory care units).

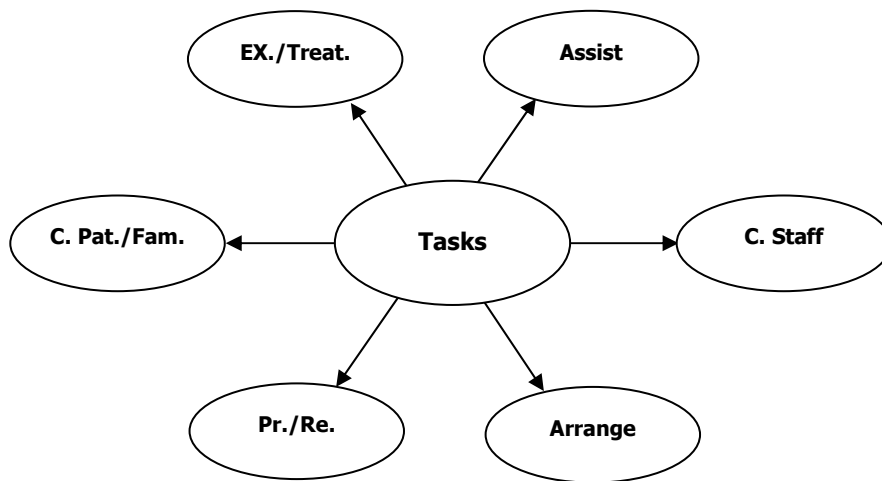


Figure 12: Tasks spectrum in the medical work processes in ambulatory care

In addition to those tasks, patient waiting time before and/or between entering the examination and treatment rooms must also be taken into consideration?.

All forms of task analysis are concerned with the description and representation of tasks and activities that are actually done. Such analysis provides organization and structure to that description. Two processes are usually followed when a task classification is conducted (Tools & Techniques, Task analysis, without year):

- The first stage is to understand the sequence of the tasks, and their interdependency. This can be done using time/structure analysis. The results of various tasks and the total time taken to complete them can be visually represented. Such representation (visualization) helps the (visually aware) designer to construct an appropriate mental model of the situation as a whole. For example, in the case studies involved, Figure 13 illustrates the time apportionment for the tasks – which have been defined before - in the general practice of the outpatient department in hospital A (in Egypt).

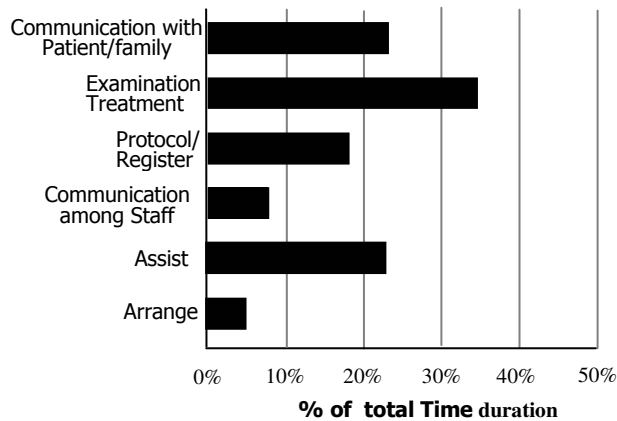


Figure 13: Time apportionment for the tasks in general practice in Hospital A (Egypt case studies). Total time duration 6:20 minutes: second

- The second stage is representing how activities fit together in accomplishing the task. Here, we show how large tasks can be broken up into smaller ones, to see the relationships that exist between them. Flow charts, tables, and other graphic representations are utilized to illustrate the latter. However, these forms are always brief and limited in description. Nevertheless, in the case studies involved for this work, the following data is considered: (a) staff comments (from interviews), subsequently categorised and featuring a summary; (b) photos demonstrating how each task is performed through a sequence of activities in the wider context of the particular clinical discipline (c) the duration of the task, the physical surroundings in which it was executed, displaying cultural and social factors. This representation is useful in evaluating the influences of the environmental design on the tasks performed, and in studying its impact on human behaviour.

4.2.2 Activities and the impact of the Context

“Visual images capture the context as well as the action of an event; they can be interpreted by multiple viewers; and the eye of the camera often freezes moments the human eye ignores” (Rosenstein, 2002). The keywords here are “context” the events (and activities), and the camera (video recording and still images). In the case studies involved, observations with video recording and still formats have been carried out studying the activities was the main goal of the analyses here. Some of the activities analyzed include complex interactions between individuals and workspaces, as well as social interactions that take place therein.

At this stage it is important to define the meaning of the word context. Context can be defined in terms of the environment or the situation. Such definitions are essentially synonyms for context, and are also difficult to apply operationally. Researchers have tried to define “context” through many different classifications. Table 5 shows the differences and similarities of elements that build context as described by different researches (Kaenampornpan & O’Neil, 2004).

Table 5: Context classification systems.

(Adapted from Kaenampornpan & O’Neill, 2004).

	Location	Conditions	Infrastructure (Computing Environment)	Information on user	Social	User Activity	Time	Device Characteristics
Benerecetti et al. (2001)	Physical Environment			Cultural Context				
Schmidt et al. (1999)	Physical Environment			Human Factor			X	
Lieberman & Selker (2000)	User Environment	Physical Environment	X	User Environment			X	

Kaenampornpan & O'Neil (2004) described the table as following:

The columns in Table 5 are extracted from elements that researchers have tried to classify as part of their context. The rows of Table 5 show different approaches from different researchers as follows:

- In the first row, Benerecetti *et al.* (2001) have classified context into the physical context and the cultural context. The physical context is a set of features belonging to the environment. Cultural context includes user information, the social environment, and beliefs.
- In the second row, Schmidt *et al.* (1999) have extended Benerecetti *et al.*'s classification into three dimensions; the physical environment, human factors, and time. Time was added because it is an important facet of context, one that has a significant impact on people's behavior.
- In the third row, Lieberman and Selker (1997) ignored time and classified context in terms of the physical environment, the user environment, and the computing environment. In this case, the user environment includes the user's location and is treated separately from the physical environment. Lieberman and Selker treat the computing environment as a separate entity, because they believe that information (such as network availability) can be of interest to the users only (Kaenampornpan & O'Neil, 2004).

Context has been defined as a subset of physical and conceptual states of interest to a particular entity. This definition has sufficient generality to apply to a recognition system, and to apply structural recognizable description of particular events. A second definition of context defines it as "any information that can be used to characterize a situation". "Situation" is defined as "the current state of the environment. The latter definitions outlined are those which are to be adopted in the case studies involved in this work.

For the study here, context is classified into four parts (clinical discipline, physical surroundings, the socio-cultural backgrounds, and the time). These parts have a definite influence on the user's activity in the medical environments (the staff and patients). This is shown in Figure 14, which illustrates the sense of context

applied to a structured description. The aim of this classification is to create a structured description for the relationships between the four elements involved (physical surroundings, clinical discipline, socio-cultural conditions, time) and how they influence the activities of the medical team and patients.

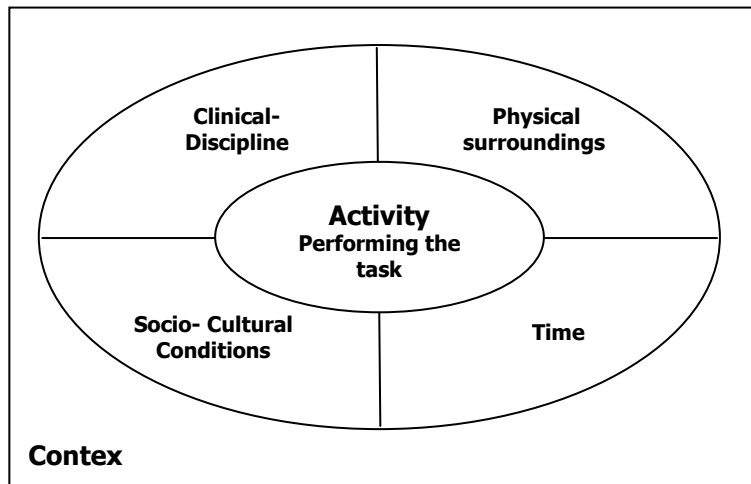


Figure 14: Model illustrating integrated context definition (physical surroundings; clinical discipline; and socio-cultural conditions) that affect any activity.

4.2.2.1 Communication with Patient and Family

Communication between the physician or other clinical staff members and the patient and/or his or her family can be termed "physician/patient interface". Such communication is an essential activity in most clinical disciplines which takes place at different stages of the medical work processes. On one hand, it is essential to the physician to listen to the patient and provide advice, and on the other it can increase patient satisfaction and compliance.

Communication takes place in many forms and for various lengths of time, depending on the nature of the medical procedure. In this way, the duration of such communication can be long and important or short with a minor importance.

The clinical discipline also affects communication. For example, in General Practice and Pediatric Practices, the duration of the doctor's consultation may account for at approximately 50% of the total time spent with the patient in the examination room. Compared to other disciplines, such as Dental Practices and ENT Practices, communication with the patient is approximately 20% of the total duration. Figure 15. and Figure 16 illustrate average amount of time required for a consultation. It is then possible to compare the task of consulting with other tasks, in both the General Practice and Pediatric Practice. The information was collected from the case studies undertaken in Germany and Egypt.

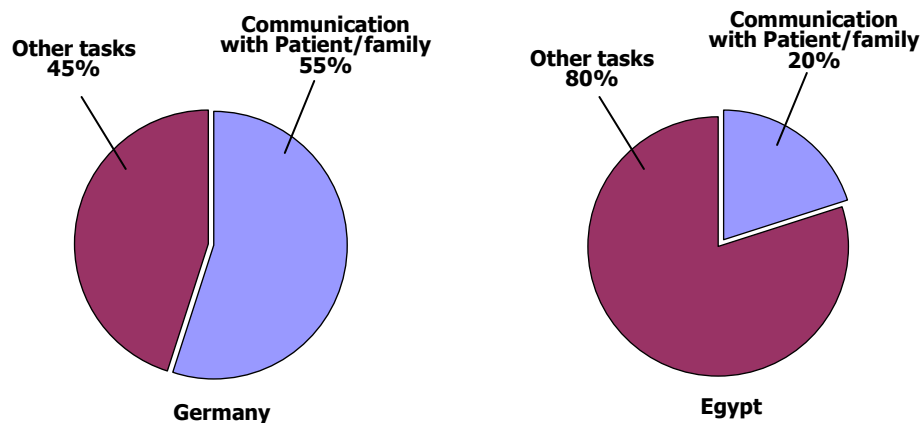


Figure 15: Proportion of time (sampled average) for the communication with patient/family "task" compared with the other tasks in General Practice. Case studies undertaken in Germany and Egypt.

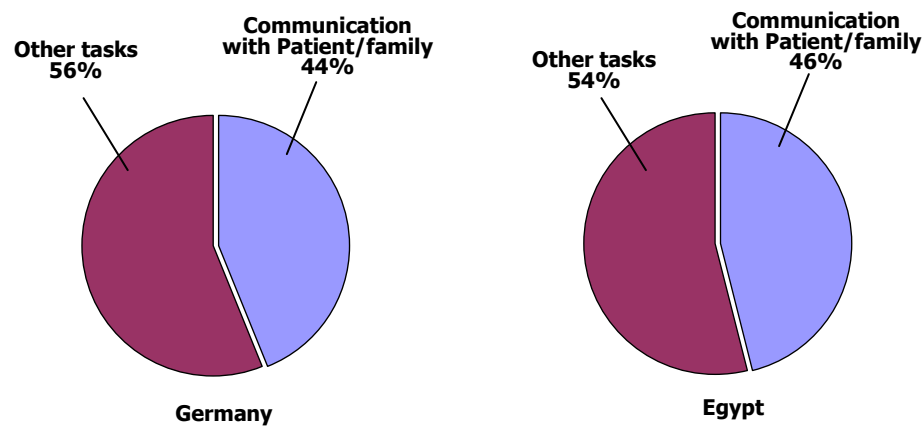


Figure 16: Proportion of time (sampled average) for the communication with patient/family "task" compared with the other tasks in Pediatric Practice. Case studies undertaken in Germany and Egypt.

The interviews conducted with the clinical staff carried out throughout the case studies demonstrate that the consultation is one of the areas that must be improved in medical environments. Table 6 shows comments made by staff, taken from the case studies performed both in Germany and Egypt on the subject of their difficulties in the Doctor-Patient interface caused by the design of the environment.

Table 6: category of staff's comments –doctor-Patient Interface

Staff's comments in Germany	Category	Staff's comments in Egypt
<ul style="list-style-type: none"> ▪ untidy desk, with no place for patient, which means the doctor must sit with his back to them ▪ Patient-doctor positioning could be improved ▪ The desk with computer should be rearranged, so that eye-contact with the patient is possible, during which their data can also be entered in the computer 	Doctor-Patient Interface	<ul style="list-style-type: none"> ▪ The sitting arrangement makes doctor-patient communication and interaction more difficult ▪ Patients can arrive with other family members, so sitting arrangement must be adjusted accordingly ▪ Sitting arrangement is not well adapted for parent-child consultation

To demonstrate the effect of the design state of the environment on this essential activity (Doctor-Patient and/or family communication), Figure 17 illustrates an example for a poor layout of the examination room, where the doctor enters the patient data into the computer and her back is facing the patient.



Figure 17: Doctor-Patient Interface - Poor Layout.



Figure 18: Doctor-Patient Interface -Poor sitting arrangements

Often the physician needs to communicate with one or more members of the patient's family (particularly in pediatric practices and in the case of elderly patients). The photos shown in Figure 18 are taken from video footage and illustrate examples of poor seating arrangements that hinder communication, eye contact, and result in a certain amount of discomfort (physically) and the tension of such closed body language that this creates for the patient's family members. This closed body language hinders an open consultation with the patient and their family. Thus, the alleviation of the patient's anxiety (or the parents for their children's wellbeing) becomes more difficult. It also makes the establishment of rapport with the physician all the more difficult. The physician requires accurate and sufficient information, which is essential for the patient's diagnosis.

Video-still in Figure 19 shows another example where the poor furnishing impacts rapport established between the doctor and patient, a brief encounter, where one is face to face with the physician, can enhance the doctor-patient relation. Furnishing must provide the possibility for the patient to sit, communicate, and collaborate effectively.



Figure 19: Doctor-Patient Interface - Poor furnishing

4.2.2.2 Examination and Treatment

Usually, the main objective of a visit to a physician is to establish an examination and/or treatment procedure. In other words, examinations and treatments are the principal functionality of medical facilities. Figure 20 illustrates an example of the proportion of time for the exam/treatment activities in comparison with other activities in dental practice.

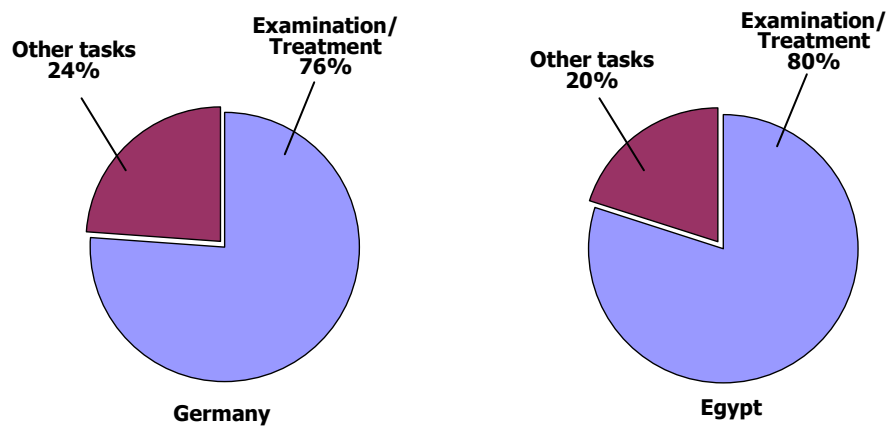


Figure 20: Proportion of time (sampled average) for the Examination/Treatment procedures in comparison with the other tasks in Dental Practice from the studies.

Most of the time, the clinical staff is engaged in the medical procedures, therefore performing interviews with them are essential in the defining phase of specifying the requirements. Categorizing the clinical staff's comments is important to the designer's analysis and observations for the work processes involved.

Access to the examination zone is an important point of our need to discussion. Table 7 shows staff's comments on this topic. Their comments highlight need for access to the examination zone, and how the designed environment there hinders and does not supports those activities which take place.

Table 7: category of staff's comments –Access to examination zone

Staff's comments in Germany	Category	Staff's comments in Egypt
<ul style="list-style-type: none"> ▪ A bed with access to both sides would be better. ▪ A freestanding examination bed, would be an improvement, from the actual bed, which is positioned against a wall, and allows access from only one side. 	<p>Access to examination zone</p>	<ul style="list-style-type: none"> ▪ A freestanding bed on all sides would allow easier access to the patient ▪ Only one side of the dentist's chair is accessible. Therefore treatment is rendered problematic. ▪ The patient is required during an examination to turn themselves round in order to received a full body examination, because the bed is against the wall

The comments above describe access problems caused by the design state. Photographs, and video still images from the case studies carried out in Germany and Egypt supported these comments. The examples below were taken from various clinical disciplines and from variety of situations.

The first example shown is taken from a dental practice in a medical center in Egypt, where the treatment room is used by more than one dentist. The dentists may be right-handed or left-handed, and the placement of the dental unit does not take this into account. Moreover, the images in Figure 21 are a still photograph taken from a mounted video camera. It clearly shows three findings (a) dentist with right hand has sufficient space to work with access to the work zone and simultaneously has the instrument and tool table to hand. (b) The other dentist is left-handed and has to remove a stool and rearrange the work space before beginning the treatment process. (c) left-handed dentist still has insufficient workspace and she could be disrupted, because she uses the entrance zone of the room. She has to change her place if she needs to pick any item from the instrument table which is placed in the corner of the room.

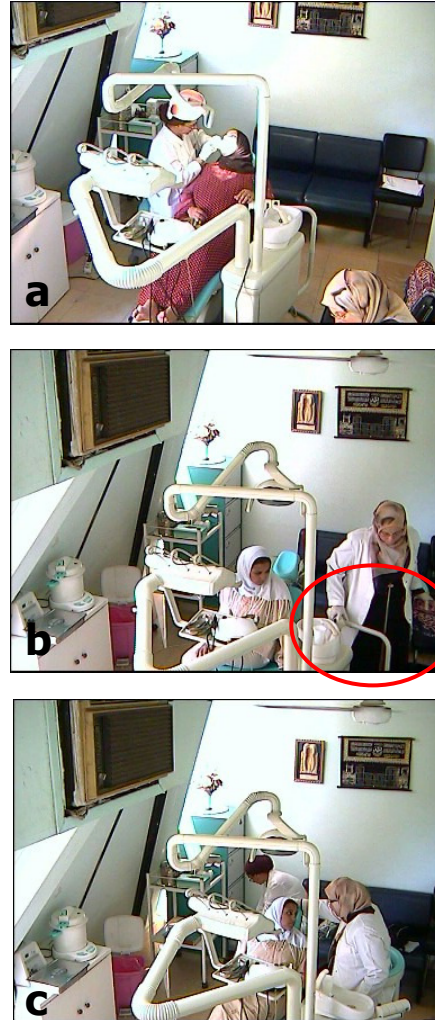


Figure 21: Access to exam zone –
Right & Left hands.

Correctly placed, the dentist's unit is accessible from both sides, right and left. This should be done not only for the reason previously discussed, but also to enable an assistant to share the work procedure with the dentist.

The problems of the access to the examination zone arise when considering the placement of the examination table. The importance of this object is often

overlooked to a certain degree, in so much that the table is placed parallel against the wall. The physician's (and/or assistant's) access to the patient is thereby completely blocked on at least one side.

Figure 22 shows (a) video-still images from an examination room in the accident surgery ambulant in the hospital of university of Duisburg–Essen. The photo shows that three sides of the exam table are already blocked and the access to the patient is available only from one side. This of course hinders the providing of any assistance, should that become necessary.

Video-still images (b) and (c) in Figure 22 show an orthopedic practice in hospital A in Egypt. The images show that the doctor requested that the patient turns himself around during the examination procedure. That is because the examination table is blocked from two sides, where the doctor could have been able to walk around the table, with access to three sides of it. It should be noted also, that the position in photo (c) provides no support for the patient's head; the support was provided only when the patient's head was against the wall.



Figure 22: Access to exam zone –
Placement of the Exam Table

Physical and/or psychological examination/treatment procedures could be conducted by the patients. During those procedures, distractions can be desirable or

undesirable, depending on the clinical disciplines and the medical work procedure at hand. There are many forms of distraction, such as music. However, the types of distraction that this study is concerned with are those caused by the physical environment (in which the clinical procedure takes place). Table 8 shows the comments made by clinical staff from various disciplines, on the subjects of desirable and undesirable distractions.

Table 8: category of staff's comments –Distraction: desirable & undesirable

Staff's comments in Germany	Category	Staff's comments in Egypt
<ul style="list-style-type: none"> ▪ Less distractions during examination, due to the layout of the room, would be better ▪ It is desirable to have a variety of positive distractions for the patient. ▪ Messiness is distracting for the patient, as is the noise and the unnatural lighting. 	Distraction – desirable and undesirable distraction	<ul style="list-style-type: none"> ▪ Untidiness unsettles the patients, as does superfluous noise and harsh lighting ▪ During examination, it would be better for children, if there were more distractions

In some cases, distraction is not only desirable but also required for many patients during a visit to the dentist. Figure 23 shows a video-still image from a dentist exam room from the case studies performed in Germany. The dentist unit is placed against the balcony which provide a view on looking the outside nature. This is an excellent source of distraction for the patient during the exam/treatment procedure.



Figure 23: Distraction –Dentist Exam Room (Germany)

In comparison with the example taken from the case studies performed in Germany, there were no sources of positive distraction in most dental examination rooms from the case studies performed in Egypt. Figure 24 shows two video-still images from a dentist exam room from the case studies performed in Egypt, from two hospitals. The patient faces the wall and no kind of positive distraction is provided. It is not always possible to provide a vision to the outside nature related to the building construction. Instead, many other "artificial" sources of positive distraction could be installed by the design of the physical environment.



Figure 24: Distraction –Dentist
Exam Room (Egypt)

The degree of distraction provided by the design of the physical environment must adapt to the nature of the clinical procedure that occurs there, and the objective of distracting the patient. Here two different examples will be presented from the case studies performed in Germany.

The photo in Figure 25 is for an EEG exam room for children. The exam continues for approximately 20 minutes and the child should be relaxed during the exam. Some children's motifs are used by the staff to make the environment familiar to the child, and at the same time provide an adapted degree of distraction. The children's characters as a form of distraction and the use of low level lighting also enhance the relaxing mood which works to distract the child from playing.



Figure 25: Distraction -EEG Exam Room (Germany)



Figure 26: Distraction -Physic-Psychical Exam Room (Germany)

Figure 26 illustrates the second example: an examination room used to perform regular check-ups for children with special needs. The concept of making the environment as familiar as home should be considered. This is not to say that this should be carried out in so far as that it would lead to incorrect results should the child become distracted or playful during the exam. The clinical staff use different tools in order to carry out their work. These tools have to be kept out of the child's sight, in order to minimize the negative distraction they could cause, that the child could play with them, or encourage a playful mood in the child, or also that they could frighten the child and make them nervous/increase anxiety.

The photograph in Figure 27 shows quite a large examination room. Half the space therein is used for the examination and the other half was used to store some medical devices. The physician remarked that the patient often become distracted by those devices which are stored in the room during the examination procedure. Therefore, it should be considered that the devises in the exam room will distract the patient attention.



Figure 27: Distraction –Present of Devices (Germany)

4.2.2.3 Assisting and cooperate among staff member

A prime example of the effect of a designed medical environment on the work processes can be derived through studying the assisting and collaborative activities amongst the clinical staff members. As noted before, the medical work processes are unique and different from one medical practice to another, according to the clinical discipline and the work apportionment among the staff. The work procedures which take place in the dental examination room are a perfect example of the assisting and cooperating activities. However, in the case studies performed in Egypt for dental examination rooms, it was noted that in five cases out of seven, the dentist has accomplished the work procedure on his/her own without any assistance.

The assisting and collaborative activities involved in the medical work procedures could be classified into the following three types:

- Parallel / Simultaneously: where there is no direct assisting and collaboration among the staff members involved, but where each staff member accomplishes a part of the work procedure simultaneously. However, the staff members could affect each other, if they share for example, one source of material or tools.
- Shared: where assisting and collaboration occur among two or more staff members in one direction, from one team member to another, or in both directions; and
- Intensive: where the staff members perform joint cognitive activities such as diagnosis and problem solving.

Examples from the case studies for those three types explained above are presented, and the effects of the physical environment are demonstrated in the following section.

From the case studies performed in the hospital of University of Duisburg-Essen in Germany, an appropriate example of the simultaneity type from the pediatric examination room, was taken. Each procedure requires approximately 50 to 60 minutes for completion. This includes an examination of the child and a consultation with the parents. Two specialists are involved in the procedure, and each accomplishes a separate part of the work procedure. A trainee is also present, who observes the work procedure as a training process. The video-still images in Figure 28 illustrates the Parallel/Simultaneous type, where is indirect assistance and collaboration among the staff members in accomplishing the medical procedure at hand. And where intervention could also happen. The design and the arrangement of the work space shown could cause that one of the specialists disturbs the other during the work process.



Figure 28: Assisting and Collaborate –Simultaneity but intervene

Figure 29 shows the plan of the room and how there is an intrusion among the personal spaces of the three staff members. This could prove to be problematic, especially if the team members are not from the same gender, as in the case discussed here.

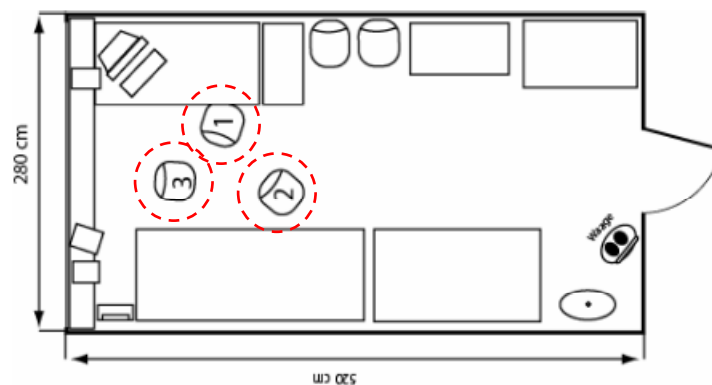


Figure 29: Assisting & Collaboration –Personal Space Intrusion.

Outside of the actual examination room, the reception station in a medical practice presents an important example of a work environment where two or three staff

members are sharing the same environment. They may not assist each other directly, but they collaborate to accomplish the work that has to be done (such as booking and scheduling appointments, storing medical recording and patients files, and cash handling duties). In the reception station, several aspects influence the work processes, such as: number of staff; work organization and apportionment; technical support; and the training of the staff involved. However, the design of the environment plays a significant role in the place efficiency and performance of the team.

From the case studies performed in Germany, Figure 30 illustrates the Shared environment by showing the situation inside and outside a reception station in a general practice. The photograph, positioned to the left, was taken from a mounted video camera. It shows three staff members sharing a limited work place, which is poorly arranged and where the placement of the office devices seems to be quite haphazard. The photo to the right shows the traffic jam outside the station which can be caused, becoming a source of a negative effect on the patients.



Figure 30: Assisting and Collaborate –Shared work environment.

“The reception station doesn’t work well”, was the comment of the physician in the case discussed here. The physician and his assistant team could not define the

problems, but the observation process conjures up images of clutter and varying degrees of disorganization to utter chaos. Image (a) in Figure 31 shows the movement of the three staff member during a busy period. The study of the traffic flow is essential in this case in order to avoid the conflicts in movement and access to the office devices and units. Images (b) and (c) show the chaos on the desks and stacks of charts. The reception stations, during several times of the day, have the highest concentration of staff members, usually in the smallest area in the practice. Therefore, additional space must be carefully planned, where a review of all the items currently within the space is made, and where a separation of the supplies and equipment are used by each staff alone or shared is done.

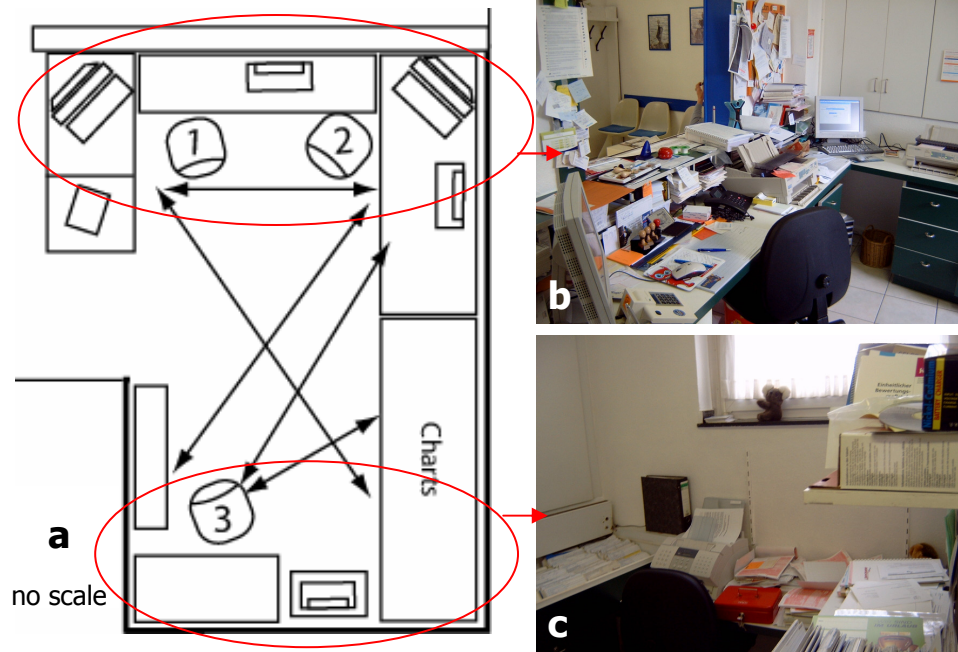


Figure 31: Reception Station.

Intensive assistance and collaboration is a type of work process where the staff members perform joint cognitive activities, such as diagnosis and problem solving. In this type of assistance and collaboration, the general work procedure and main tasks are known, but the sub tasks are not certainly known and these result in activities that are non-programmed. This raises the question of the role the designed environment can play in the case of non-programmed activities. The designed environment could put one staff member out from the area where s(he) is required. That could be for a shorter or longer time period where s(he) should be aware of the events that are taking place. From the case studies carried out, two examples are presented in comparison; a case from Egypt and a case from Germany

The first example is from a cast room, which is essential in most orthopedic surgery and out-patient departments in hospitals. In the cast room numerous splints, bandages, and other necessary tools are utilized. Therefore the cast room should be designed precisely to accommodate the use of those resources of materials and tools.

In different stages of the work procedure in the cast room, materials and tools will be needed, and one of the staff team has to deliver them to the work zone. Figure 32 shows video-still images for two different cast rooms.

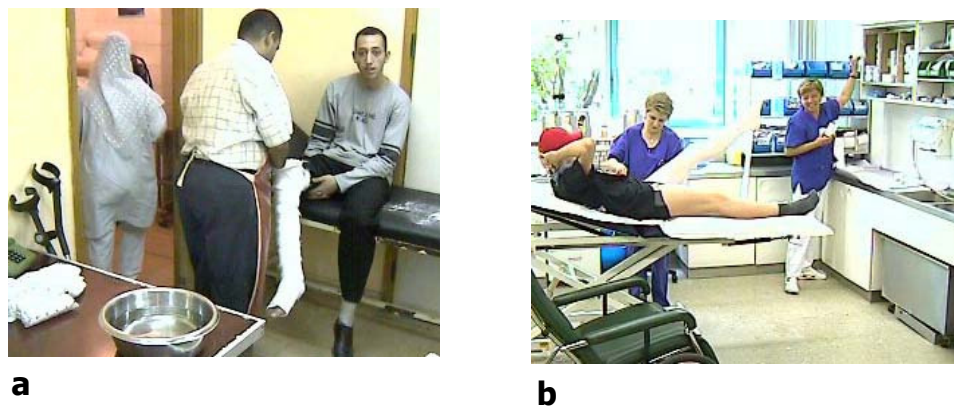


Figure 32: Cast Room –deliver materials and tools .

Image (a) in Figure 32 shows that the cast room in hospital A in Egypt is separated into two rooms or sections. The image shows that the assistant has to leave the work zone in order to pick up needed material and tools, which means that she will not be aware of all events occurring in the work zone during her absence. In contrast, image (b) shows the cast room in the hospital of the university of Duisburg-Essen, where the cabinets accommodate materials and tools are placed near to the work zone. This enables the assisting member of staff to be aware of the events taking place in the work procedure.

The second example is driven from the dentist treatment room. Malkin (2002) comments on the design of a dentist treatment room, writing “a matter of inches can make a critical difference in the efficiency of a treatment room” (Malkin 2002). Figure 33 illustrates and compares between two treatment rooms, the video-still image on the left is taken from a treatment room in Egypt, while the one on the right is from a treatment room in Germany. Image (a) illustrates how the assistant has to go out and stay far away from the treatment zone in order to prepare and deliver some items. In contrast the image (b) shows that assistant stays near to the dentist and the work zone, and is aware of what is going on, and requires only a short time to bring the required items in the work zone.

**a****b**

Figure 33: Dentist Treatment Room –deliver materials and tools .

4.2.2.4 Communication among Clinical Staff Team

Communication among the clinical staff team has often been cited as the primary mechanism of staff collaboration. The communication among the staff team members could be classified into the two following types:

- Face to face communication: This includes verbal and nonverbal communication.
- Communication through technical supplies (not face to face): such as using telephones, wireless communication devices, and computer networks. This type should be considered when designing workstations in order to integrate the communication devices in the workstation in the way that they add to the efficiency of the work station.

Layout of the physical environment and the presence of various artifacts or physical objects has a direct effect on the face-to-face communication among staff members. When people work in close proximity, nonverbal communication may become one of the vital and efficient ways to exchange information (Xiao & the Lotas Group, 2001). In this sense, eye contact between staff members is essential to achieve successful communication during the work procedures. Thus, the cast room from the case studies performed in Egypt clearly demonstrates how the layout of the room can lead to a lack of communication between the staff members.

The video-still image in Figure 34 from the case studies in Egypt, shows that the assistant is standing behind the doctor, where no eye contact could be established. This affects the nonverbal communication, but also impedes the reaction of the assistant to the doctor's verbal orders.



Figure 34: Cast Room –lack of Communication

In most practices, the reception station or front office is the control center of all the work flows in the practice. This is due to the fact that it is the receptionist's responsibility, to manage the flow of the patients between examination and treatment rooms and the waiting area.

On one hand, a receptionist must see the patient on arrival and before leaving, all the while retaining a good view of the waiting area. On the other hand, they must also be able to see the exam and treatment rooms. This is so as to enable the doctor or another staff member to have eye contact with the reception unit. This makes it possible to give and carry out orders, which may be verbal or nonverbal, e.g., for the next patient to come through or for the next procedure to be carried out with the last patient. Figure 35 illustrates a floor plan for an General Practice, where the staff member at the reception cannot see into the waiting room, one of the examination room, the laboratory, nor to the entrance of the practice.

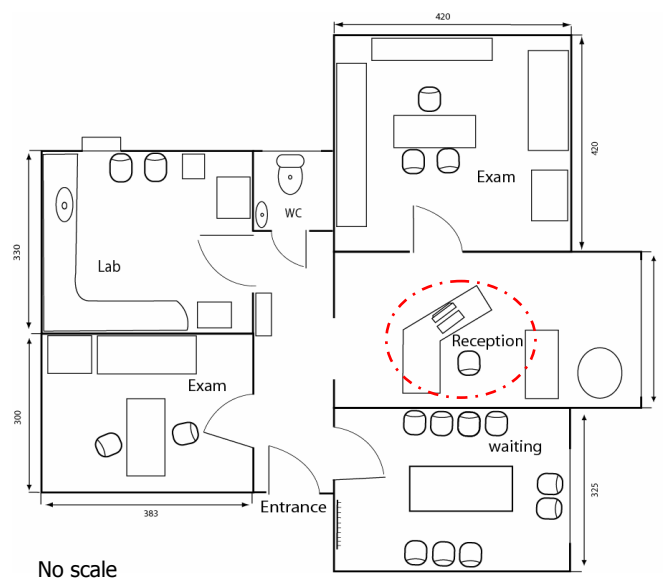


Figure 35: Space plan for general practice -Reception with no view access.

Figure 36 illustrates a floor plan for an ENT (Ear, Nose, and Throat) practice, where the receptionist has visual access to the waiting room, the examination rooms, the laboratory, and can almost see the entrance of the practice.

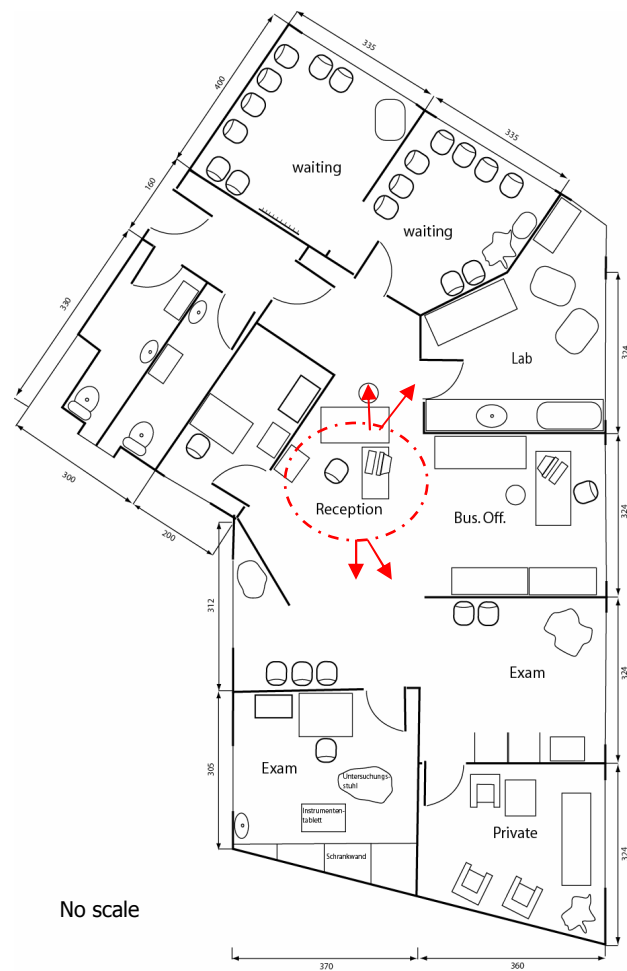


Figure 36: Space plan for ENT practice -Reception with view access.

4.2.2.5 Arrange: arrange material, tools, and/or place

Arrange activities could take place before or after the examination procedure. This would be to rearrange the used tools, remains of used material, and the space itself after one examination and prepare what is needed for the next medical procedure. The arrangement activities could be made into an ordinary procedure, as in the case of the exam room in General Practice or pediatric practice, or more complicated, as in the case of cast rooms or dental treatment rooms.

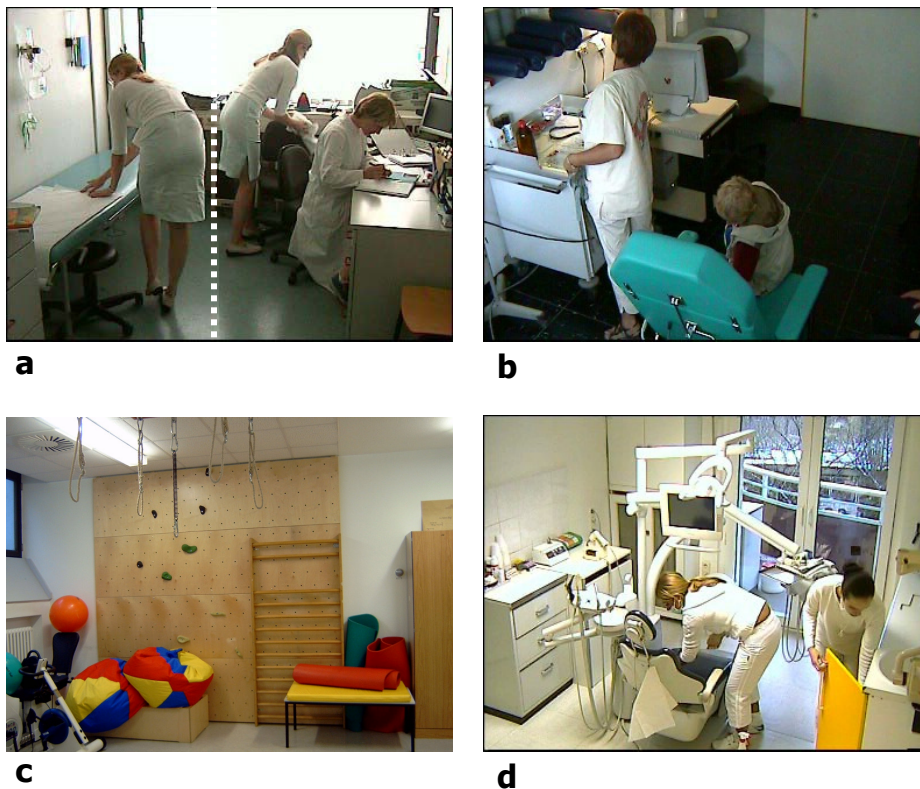


Figure 37: Arrange –arranging procedures in different exam rooms.

Figure 37 shows a number of video stills showing the arranging of the exam rooms after one examination before the next takes place. There are varying degrees of complication to the tasks involved. Image (a) shows the assistant staff member in a pediatric exam room as she exchanges the exam table paper, which must be discarded after every patient, and throws it in the receptacle; the only one in the room under the doctor's desk. Two receptacles would have avoided disturbing the doctor's desk. Image (b) shows the situation after an ECG exam where the staff member need to rearrange cables and cushions, which support the child's head during the exam, into a side cabinet. Sufficient work surface should be available and also the height of the rack should be taken into consideration. Image (c) shows how several testing instruments could be used in the physical exam for children with special cases. The test tools and mattress need to be stored away, rather than occupying the space and hindering other procedures which do not require the use of those tools. Image (d) shows a more complicated arrangement procedure in the dentist's treatment room; efforts of two staff members could be needed after each patient visit in order to reduce the time required. Surfaces should be simple to clean and disinfected, and built-in receptacles should be available to access without blocking movement.

4.2.2.6 Read and Register Protocols, Patient information, and Prescriptions

Usually, the physician will need to read the patient's file for notes taken prior to the examination. Similarly, after the examination is completed, they note the results. There are many ways to perform this task: using the patient's card or files, a computer, or dictation tapes (later to be transcribed by one of the assistants). The facilitates and features available in every case should be considered in the designing of the medical workplace.



Figure 38: Read and Register Patient's information and Prescriptions.

The videos stills in Figure 38 show the previously described methods of dictation being utilized in different situations. In image (a), an assistant supports the physician and notes the patient's data; in this case, the workplace should be designed to accommodate the task of the assistant. Where the option of dictating on tapes is

used, as in image (b), some aspects of the environment must be considered, particularly noise and distraction. Other example, a physician might need a dictation niche as in image (c), which is central to the examination room and reception office. Here, the height of the desk's writing surface enforces a poor work posture. It seems that using computers will become the preferred solution, along with digital medical records and patient management systems created for it. Other factors such as glare caused by daylight, as demonstrated in image (d), should be avoided when using computer screens.

4.3 Staff's Standpoint and Perspectives on the Medical Environment

4.3.1 Introduction

A structured questionnaire has been used with the medical staff to survey their satisfaction with the designed environment, the feeling of stress in the environment during the workday, and the feeling with pains at the end of the workday. That in addition to physical measurements of illumination and temperature conditions.

In addition to the questionnaire and after performing the observation processes, a semi-structured interview was conducted. This is to determine the influence of the environment on the work processes, and to define the problems faced by the staff as a result of the design state of the environment. The aim is to determine the aspects which must be considered in designing medical environments according to the nature of the work processes.

Statistical analysis for the questionnaires has been performed, and the comments of the medical staff have been categorized. This is in order to weigh the relative importance of features and conditions. The results have been tabulated and classified.

4.3.2 Stress in the Work Environment

“While reducing staff stress and fatigue through a healing and supportive environment seems like an obvious goal, there are relatively few studies that have dealt with this issue in any detail” (Ulrich *et al.*, 2004). The latter quotation by Ulrich and his team mentioned the current state of research on stress and fatigue of

hospital's staff. It is more true that less research has been performed on staff stress in medical practices and out-patient units in hospitals.

Since people are different, it means that one individual differs from another in their capability to perform tasks (Kroemer *et al.*, 2001). There are many sources of stress in the medical environment during the workday, which could have different levels of effect on one individual than another. Figure 39 is a classification of the stress sources.

Possible Sources of Stress in the Designed Environment

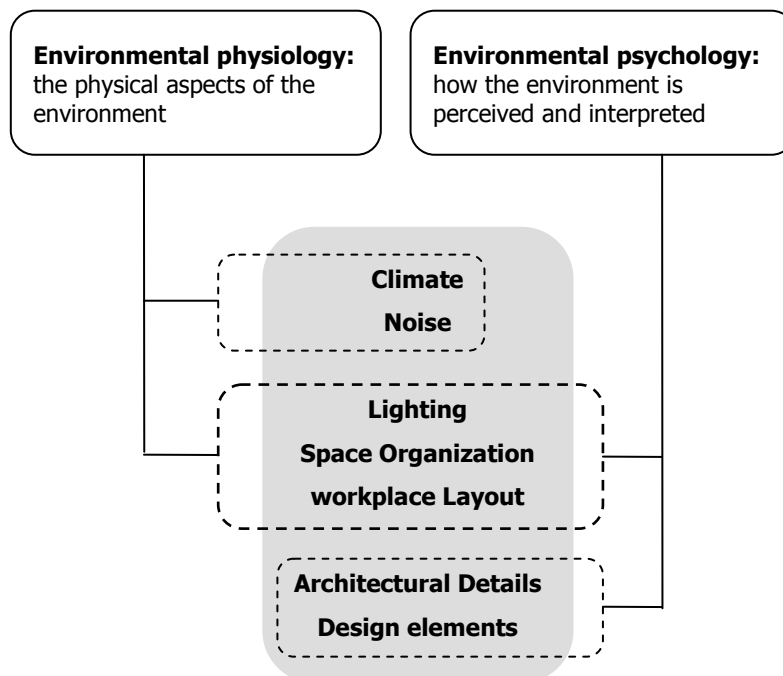


Figure 39: Diagram illustrating the possible sources of stress in the designed environment.

“Stress is physical and cognitive” (Kroemer *et al.*, 2001). According to Mears (2005), physical and mental stress will impact the professional performance of an individual in many ways, and there is a need to reduce that stress, both physically and mentally. Figure 40 illustrates the relation between the stress level and the causes of it. The degree of stress can be decreased by lowering the intensity of the stressors.

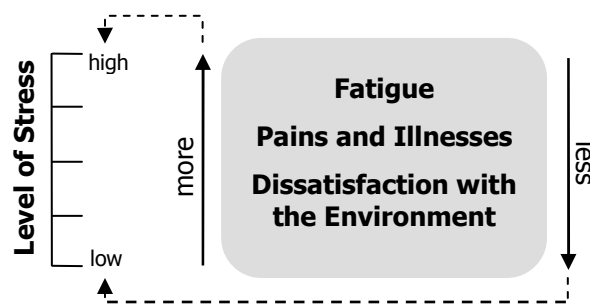


Figure 40: Causes of stress in the designed environment and necessity of reducing them.

An important part of the questionnaires given to the medical staff was to find out what level of feeling stress was reached during the work day in the medical environments. This include both mental and physical stress. In addition to that, the feeling levels of being stressed caused by climate, lighting, and noise in their working environment were determined.

Table 9 contains diagrams to illustrate the averages of respondent Feelings to Stress levels from the case studies performed in Egypt. Five levels of stress have been defined, starting from (0) which means no stress to (4,0) very high levels of stress.

Table 9: Averages of staff's Respondents Feelings to Stress levels (case studies performed in Egypt).

	Medical centres							Hospitals						
	City			Town		Village		Hosp. A					Hosp. B	
	GP	Pediatric	Dental	Pediatric	Dental	Pediatric	Dental	GP	Dental	ENT	Ophthalmologic	Orthopaedic	GP	Dental
Mental Stress	2,0		3,0	1,8	1,8	2,0	2,3	2,3	0	2,3	4,0	1,7	3,5	1,5
Physical Stress	1,2		3,5	2,2	3,0	2,0	1,8	1,7	1,7	1,7	4,0	2,0	3,0	2,2
Stress bec. of Climate	3,5		3,5	2,2	2,8	0,5	1,8	0,7	0,3	0	2,0	2,3	3,0	0,4
Stress because of Light	1,8		2,0	1,8	2,0	1,5	1,8	0,7	0	0,7	3,0	0,7	1,0	0,6
Stress because of Noise	0		4,0	0,8	2,8	1,0	1,0	2,0	0,3	1,0	0	0,7	4,0	1,3

Average of Stress Level

4,0

3,0

2,0

1

0

Very high

high

middle

low

no

Notes: in the paediatric ambulatory of the medical centre in the city the doctor refused to take part in the questionnaire.

According to the interviews performed with the medical staff, the mental stress is present most of the time. This mental stress is caused by the low organization in the

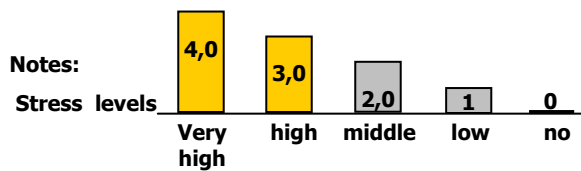
work environment which are mainly related to the principle of not making appointments for the patients. However, it could be seen from the diagrams that in most cases a relative relationship can be drawn between the mental and physical stress levels. Regarding the hypothesis of the dissertation, the physical aspects of the medical environments must be adapted. In 6 out of 13 cases the physical stress average has exceeded the middle level (2,0). That could be linked and detailed by the diagrams of the stress average caused by climate, lighting, and noise. The case studies have been performed in Egypt during the summer months. Regarding the climate, where the facility is supplied with air-conditioning or ventilators, the stress averages are in the low level. Where neither is fitted, the stress averages exceeded the high level (3,0). The low averages of stress caused by lighting could be understood as nature light in summer, especially in Egypt, has provided a positive effect and an adequate level of illumination. In two cases, the stress averages caused by noise reached the high level. The cause of this is the use of old equipment and defect ventilators, which result in loud noise.

Table 10 contains diagrams to illustrate the averages respondents Feelings towards Stress averages from the case studies performed in Germany. The diagrams show that the averages of mental stress in 9 out of 11 cases exceeded the middle level (2,0) and in 4 these cases it exceeded the high level (3,0). According to the interviews with the medical staff in Germany, the main reason is the time pressures, i.e., to keep appointments on schedule and to accomplish the examination and treatment processes for each patient in the limited allocated time. Hence as a hypotheses in the dissertation the work environment should be designed effectively to support the work processes.

The averages of the physical stress as shown in the diagrams in Table 10 are in 8 out of 11 cases less or in the middle level, in comparison with those in Table 9, that are in a better state. It is related to the optimized workplaces (disks, chairs, compute workstations, other equipments) in German work environments (in general) as opposed to those in Egypt.

Table 10: Averages of staff's Respondents Feeling to Stress level (case studies performed in Germany).

	Practices						Uni. Hosp. Essen				
	General			Specialized			Pediatric			Surgery	
	Practice A	Practice B	Practice C	Pediatric	Dental	ENT	General	EEG	Ergo therapy	A&E	Neurological
Mental Stress	2,5	3,5	1,7	2,8	1,3	3,4	3	2,5	3,7	2,3	3,5
Physical Stress	0,8	2,5	2	2	1,7	2,4	0	2	2,3	2	2
Stress because of Climate	0,8	1	0,3	2,5	3	2,2	4	3	2	2	2
Stress because of Lighting	1,5	1,5	1,7	2	2,3	3,4	3	2,5	2,7	2,6	1,5
Stress because of Noise	1	2	0	2,5	1,7	2,4	0	3,8	1,7	1,7	1,5



In Table 10, there are two rows specifying the stress caused by climate and lighting which should be compared with the temperatures and illuminations data presented in Table 11 and Table 12. It can be seen that where the temperatures

values were in the range between 21 and 22 degrees, the subjective stress were at the low levels.

The same should be done with the average levels of stress caused by lighting. It can be seen that in 5 out of 11 cases the stress average caused by lighting are less or at the middle average level (2.0). In these cases, the illuminations ranged between 300 and 1000 lux, as shown in Table 12. Otherwise, in most of the other cases, when the illuminations is out of this range, then the stress average exceed the middle level (2.0). One should pay careful attention to the relationship between stress average and the illumination levels at the computer workplaces. Particular example, in the case of general pediatric ambulatory in the university hospital in Essen. The illumination at the computer workplace has recorded 720 lux and the stress average is on the high level (3.0). The adequate illumination level at computer workplaces should be in the range of 350 to 500 lux. In Table 12 it could be seen that the illumination levels have been out of this average limit in 7 out of 11 cases. Glare on computer monitors can be also problematic and it should be considered.

The interviews have been completed with measurements of the temperatures and the lighting levels.

Table 11: Temperature levels.

	Practices						Uni. Hosp. Essen				
	General			Specialized			Pediatric			Surgery	
	Practice A	Practice B	Practice C	Pediatric	Dental	ENT	General	EEG	Ergo therapy	A&E	Neurological
Temperature	22	21	21,5	25	25	24	19	23	23,9	22,5	23

Table 12: Illumination levels.

	Practices						Uni. Hosp. Essen				
	General			Specialized			Pediatric			Surgery	
	Practice A	Practice B	Practice C	Pediatric	Dental	ENT	General	EEG	Ergo therapy	A&E	Neurological
Computer workplace	620	500	400	500	2250 D.L.	530	720	190	370	1400	700
Exam area	400/450	550	360-420	300-400	1000	600	650	260	250-390	450	550
Side surfaces/ cabinet	1000	400	500	280-340	200/500	330-550	600/350	360	340	315	500
Doctor's disk	400	350	500	300	200	220	690	700	300	1400	1000

Notes: illumination are measured in lux unit; D.L.: Daylight

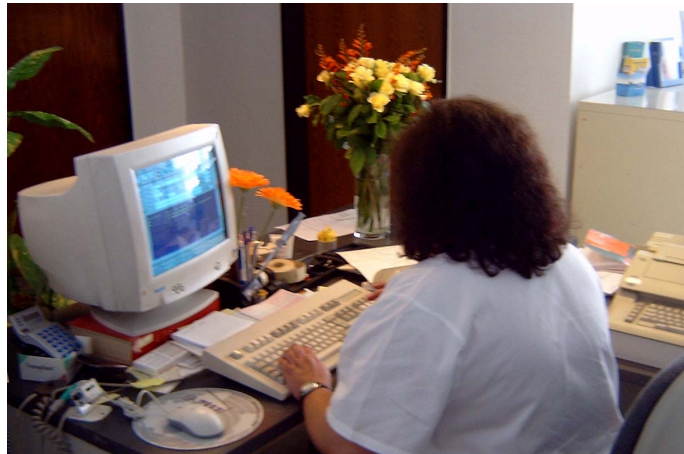


Figure 41: Glare on computer monitors.

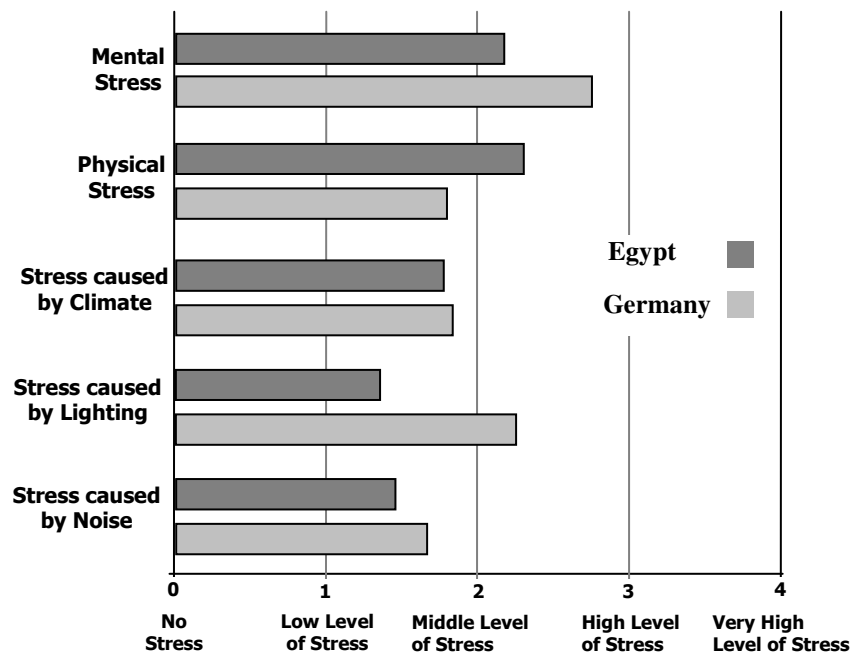


Figure 42: Comparing the middle average of stress levels of the case studies in Egypt and Germany

Notes: the number of the included medical staff in the case studies

Egypt Doctors: 30; Assistant: 17.

Germany Doctors: 17; Assistant: 20.

An important issue and goal of performing the case studies in Egypt and Germany is to define the differences in the nature of the problems facing the medical staff in their work environments in both countries. Figure 42 serves as an overview to the stress averages of the total case studies performed in Egypt and also that of Germany.

The diagrams in Figure 42 show that the medical staff included in the cases studied in Germany face more mental stress as those included in the case studies of Egypt. On the other side, they are subjected to less physical stress than the medical staff included in the case studies of Egypt. As mentioned before, in general the work palaces in Germany are better ergonomically optimized as in Egypt. However, the medical staff in Germany may face more time pressure and restrictions (related to medicine laws and insurance systems), which they should pay heed to all the times. Secondly, attention should be given to the averages of stress caused by lighting. The averages exceed the middle level (2,0) for the medical staff included in case studies performed in Germany. It is probable that this is linked with the increasing use of computer technology in the medical environments in Germany as in Egypt. It could also be linked to smaller amounts of natural daylights in the rooms, due to the differences in the nature of the weather.

Regarding the stress caused by noise it can be seen – particularly in Figure 42 - that the total averages are less than the middle level (2,0) in the countries. However, it should be mentioned that where complaints of noise have been logged, the cause of this came from outside the work environment.

With the questions of the stress follows an important question on the feeling of physical pains at the end of the work day. The answer to which should be simply

there is pain (Yes) or there is not (No). If the answer was positive, then the medical staff member had to explain which type of pain.

Feeling of Pains

Poor ergonomic design of workplaces, exam beds, and nurses' stations leads to back stress, fatigue, and other injuries among medical staff. Figure 43 shows the percentage of the positive answer of pains feeling at the end of the workday from the case studies performed in Egypt and Germany.

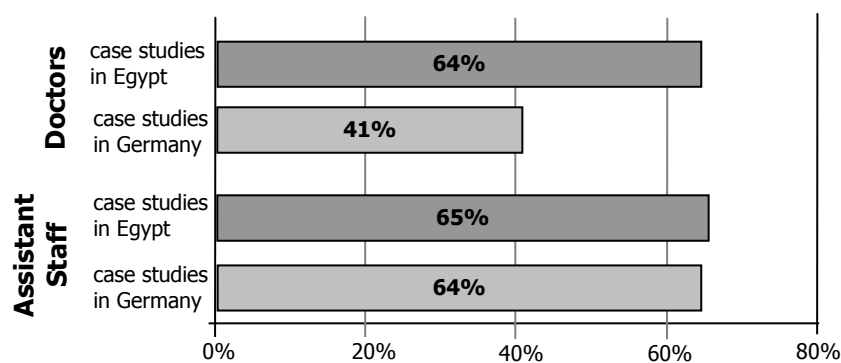


Figure 43: Percentage of the positive answers of pains feeling at the end of the workday

Doctors included in the cases studied in Germany have been recorded the minimum percentage of feeling of pains (41%). This provides evidence for the observation that the workplaces and medical furniture and equipments are better ergonomically designed than in Egypt. However, all percentages show that there is a high percentage of those who feel various kinds of pains at the end of the workday (3 diagrams exceeded the 60% mark). This means that there is a huge need to modify existing medical environments and the elements inside them, to more ergonomic approaches.

Four types of pains have been defined from comments made by staff:

- **Back Pain**
- **Shoulder and Upper Arms Pain**
- **Neck Pain and**
- **Feet Pain.**

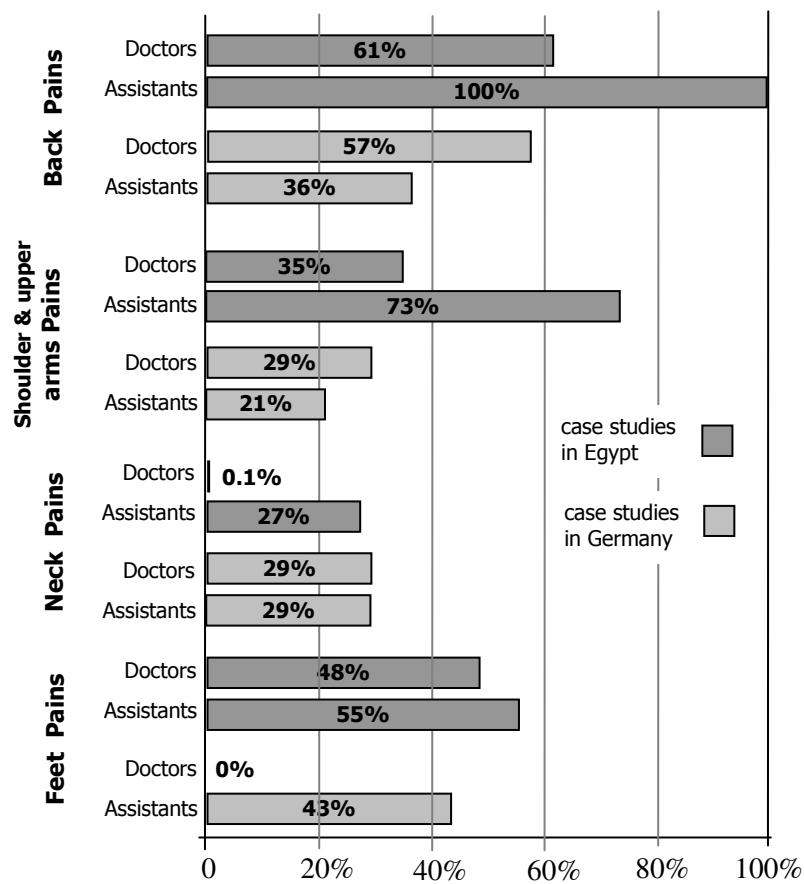


Figure 44: Percentage of the types of pains at the end of the workday.

As shown in Figure 44, back pain is highlighted as the most frequently occurring pain type facing the medical staff (especially the assistant staff included in the cases studied in Egypt). Back pains were recorded as the most frequently experienced higher percentage of pains type by doctors included in the cases studies in Egypt and Germany. From the diagrams it can be seen that medical staff surveyed in Egypt experience more pains than those surveyed in Germany.

4.3.3 Environmental Satisfaction

The medical environment as a work environments must be modified and adapted ergonomically in order to minimize stress and pains. Yet, all factors and conditions could not always be adapted by the designer. However, a well-designed environment will affect satisfaction which could strengthen one's ability to cope with stress. On the contrary the dissatisfaction within the designed medical environment may be itself a source of stress and frustration, and thereby affect the social life and health of the medical staff. Hence, an imperative part of the questionnaires was to ask the medical staff about their experiences and general satisfaction within the physical environments.

Different aspects shape the physical environment. Five aspects have been defined:

- **Room's size**
- **Furniture climate**
- **Lighting**
- **colours and**
- **Art works.**

Table 13: Averages of Staff's Response to the different aspects and of the environment in general (from case studies performed in Egypt).

	Medical centres							Hospitals						
	City			Town		village		Hosp. A					Hosp. B	
	GP	Pediatric	Dental	Pediatric	Dental	Pediatric	Dental	GP	Dental	ENT	Ophthalmologi	Orthopaedic	GP	Dental
room's Size	3		3.1	2,8	3,3	4	3	2,4	3	3,7	0	2	2	3,7
furniture	3,2		4	3,2	3	2	2	3,2	3,3	3,7	0	2.3	2	3,8
Climate	2,4		1,6	2,2	2	3	2,5	3	3.3	4	2	2,3	0,5	3,8
Lighting	3,2		2,6	2	2,5	1	1,8	3	3.3	4	1	3	2	4
Colours	2,6		3,3	3	3	1	1,8	3	2	4	3	3.3	2,5	3,6
Art works	1,8		2,1	1,4	1	1	1,3	2,4	0,7	0	0	1,3	0,5	2,5
Overall the Environment	3		3,1	3	3	2	2,3	2,9	3,3	3,7	2	2,3	2	3,8

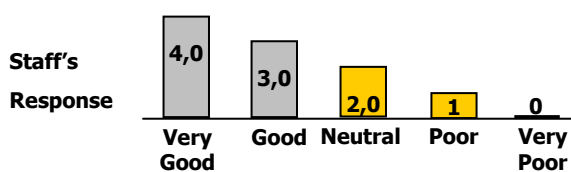


Table 14: Averages of Staff's Response to the different aspects and of the environment in general (case studies performed in Germany).

	Practices						Uni. Hosp. Essen				
	General			Specialized			Pediatric			Surgery	
	Practice A	Practice B	Practice C	Pediatric	Dental	ENT	General	EEG	Ergo therapy	A&E	Neurological
room's Size	4	3,5	3,7	1,3	1,3	3,6	4	2,5	1,6	2,7	3,5
furniture	3	3,5	1,3	2,8	2,7	1,8	4	2,3	1,6	2,3	2,5
Climate	4	3,5	3,7	1,3	2,3	2,6	4	1	1,3	2	3
Lighting	3,8	3,5	3,3	2,3	3	1,4	4	2,8	2	1,6	3
Colours	3,8	3,5	3,7	3	3,3	3	4	2,8	2	2	3
Art works	3,0	3,5	3,7	2,3	3	2,6	4	2,5	2	1,6	3
Overall the Environment	3,2	3,5	2,3	2,5	2,7	2,2	4	1,8	2,6	2,3	3

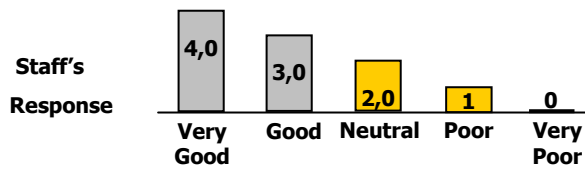


Table 13 and Table 14 present averages taken of the staff's response to the different aspects of the environment and, in addition, to the respondents feeling to the environment in general.

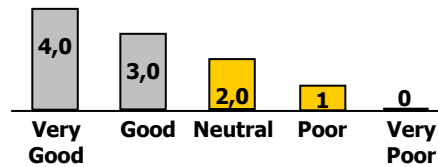
Aspects such as climate and lighting should not only be measured and evaluated as physical conditions, but they should be also assumed as environmental satisfaction aspects. For example, in addition to the temperatures there is the smell, an awareness of the closed windows, and air conditioning system and units. In addition to the illumination levels, the type of the lighting sources plays a role and the form of the light elements whether it is fashionable and trendy or old and out of fashion.

As a general approach to the man-made-environment, the time has come to raise expectations for built environment performance and aim 100 percent satisfaction with the designed environment. Through the analysis of the cases studies performed in Egypt and Germany it could be seen to what extent the medical staff are satisfied with their particular environments, where the concern is in dealing with human health. Table 13 and Table 14 contain diagrams illustrate the averages of staff's response toward the different aspects and to the environment itself in general. Table 13 shows the most criticized aspects, which is in respect of the art work. The absence of art works was noted by most of the cases in Egypt. In Germany, and as show in Table 14 this is not the case, it is the furniture, which has come under critic. Here, the medical staff showed a desire to have more modern and fashionable furniture. In the second stage of negatively responses in the case of both countries was the aspect of climate condition. In Egypt this related to smell of disinfectant materials, which is a worse situation with air-conditioning. In addition to the high the temperatures in summer. In Germany, the absence of fresh air was the main complaint. In both countries criticisms from the medical staff regarding fluorescent and direct light systems have been noted. In Germany there is also the absence of the natural daylight in the environments to consider.



Figure 45: Example for averages of the staff's response to furniture from the cases studies performed in Germany.

Notes: **Staff's Response**



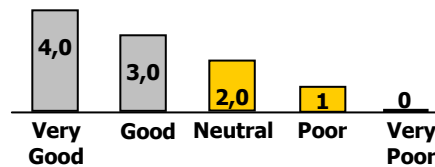
Regarding the colour scheme used in the medical environment for the case studies carried out in Germany, colour is the least criticized aspect. Where it has been criticized, the white colour was the more frequently used on painted walls and furniture colour. In Egypt the white colour was the more preferred colour as a sign of cleanliness and hygiene.

For the case studies conducted in Egypt, as the medical staff were questioned on the satisfaction within their designed work environment, for them the question was some kind of asking about luxury. The technical supplies and having access to modern equipments and tools was more important to them. Table 13 shows clearly that respondents feeling toward the overall the environment. The lowest average was in the neutral level (2,0). In 6 out of 13 the averages were less as the good level (3,0).



Figure 46: Example of the averages of staff's response feeling to overall the environment from the cases studies carried in Egypt.

Notes: **Staff's Response**



Regarding the cases studied in Germany, the averages of staff's response toward the overall environment was less than good (3,0) in 7 out of 11 cases. Renovations and rearranging the workspaces and places, and supplies with new furniture and lighting systems were the main desires. In addition to that, the complains of the scarceness of space (where more spaces are desired), are also priority. This has been linked in the most cases to less privacy in the workplace and also problems in providing private

workplaces in addition to the main requirement of space needed for the work process.

Aside from the questionnaire and after carrying out observations, remarks were noted, semi-structured interviews with medical staffs were conducted. This was done in order to seek out problems, advantages, and disadvantages in the designed environment from the point of view of the medical staff members. As previously mentioned, behavior is a continuous stream of interaction between person and environment, and not a sequence of discrete responses. The medical staff have expressed, in their comments, aspects of their experience within their work environments. The comments of the staff were organized and from them categories have been defined. The Categories are as follows:

- **Doctor-patient interface**
- **Access to examination zone**
- **Distraction –desirable and undesirable distraction**
- **Technical supplies**
- **Value of space**
- **Orientation**
- **Disruption**
- **Privacy**

Part of this categories have been discussed in the section dealing with analyzing of the work process and the influence of the designed environment. the remainders shall discussed in this following.

Next, the categorized summary of medical staff's comments in both Egypt and Germany on their work environment

Table 15: Category of staff's comments –Technical supplies.

Staff's comments in Germany	Category	Staff's comments in Egypt
<ul style="list-style-type: none"> ▪ With check ups one should go with the children to room 2 in order to weigh and measure them. ▪ Sources of danger, through exposed wires laying around. ▪ Stretchers are difficult to handle ▪ The advantages of such rooms are that they are fitted with scales, height gage, and vaccination ▪ the advantage of this room, is that it is equipped with scales, bandages, and has the facilities for vaccinations. ▪ The benefits of this room is the patient chair, which is equipped with x-ray equipment, mini camera, and monitors ▪ The advantage is the camera, monitor and the modern style of the patient chair ▪ The room needs a new desk, and lighting, in order to be brighter 	Technical supplies	<ul style="list-style-type: none"> ▪ More modern furnishings and equipment would be desirable ▪ The equipment is quite old, newer furnishings would be desirable ▪ Fixtures and fittings are not well installed and this is a cause for concern ▪ New furniture is needed for the doctor's workplace ▪ Computers would be an improvement in the organization of patient data ▪ Patient files at the moment take up a lot of space, a new system would be a vast improvement ▪ Equipment is shared between different room, and having it all available in one room would be desirable

Regarding the nature of medical environments using medical and technical equipments and tools. Technical supplies are an essential requirement. This highlighted from comments in Table 15. Providing technical supplies is seen as more advantage in the environment, and the disorganization of those supplies will lead to criticism and complaints of the work environments.

Table 16: category of staff's comments –Value of space.

Staff's comments in Germany	Category	Staff's comments in Egypt
<ul style="list-style-type: none"> ▪ At this practice are only individual cubicles, which have inadequate space. ▪ Body motor function testing is limited to the room size ▪ Too many processes take place in 1 room: examination, consultation, distribution of work to staff, and patient registration. ▪ Examination cubicles are altogether too narrow ▪ Too small ▪ The room is too small, especially when many patients ▪ The room is somewhat too small. ▪ Treatment room is small and poorly laid out (lack of space) ▪ the room is problematic because 3 specialists must share the space, and each perform their tests on the children. ▪ a bigger room would be better ▪ Examination cubicles are altogether too narrow ▪ lack of space ▪ the layout renders the room too narrow ▪ too narrow ▪ The advantage of this room is that it is actually spacious. ▪ the fact that it is a large room is excellent. ▪ A bigger test room would be better. ▪ The best solution would be to have 2 rooms of the same size ▪ 2 rooms instead of 1(situated next to each other) would be better 	Value of space	<ul style="list-style-type: none"> ▪ There is not enough space, so more space is desirable ▪ More space is desirable ▪ The size of the room is adequate ▪ It is narrow ▪ The size of the room is not sufficient to house the number of patients ▪ The room should be larger.

As it could be seen in Table 16 the German staff's expressed nineteen comments on complaining about the lack of space, which is more problematic than that in the case studies in Egypt. The cases in Germany should be linked with the fact that most medical offices are leased spaces. In hospitals, there is the increase in medical

specializations, which need to occupy in the same spaces. Thus a more effective use of space must be created.

Table 17: category of staff's comments –Orientation.

Staff's comments in Germany	Category	Staff's comments in Egypt
<ul style="list-style-type: none"> It is often difficult for the patient to get his/her bearings 	Orientation	<ul style="list-style-type: none"> Every patient has to be told where to go and where to wait Finding the right room is often difficult and is time consuming

As for the orientation, especially in hospitals and medical centers, it is obvious that the medical staff from both Egypt and Germany face a burden from the need to aid in the patient orientation. The assistant medical staff, as well as the doctors, seems to spend much time on guiding the lost patients to their destination, one after one, in a process which seems never-ending and time consuming. In Germany the signs presence do not help in alleviating the sense of being lost, while in Egypt the signs absence cause even more problems in guiding the patients step-by-step.

Table 18: category of staff's comments –Disruption.

Staff's comments in Germany	Category	Staff's comments in Egypt
<ul style="list-style-type: none"> Heightened acoustics (very thin walls between rooms) unwanted noise disrupts examinations, and patient consultation 	Disruption	<ul style="list-style-type: none"> Noise both inside and outside the room, due to queuing patients Because there is often more than one patient in the room at any one time, noise reach disruptive levels. Lack of organization (no appointments etc.) causes disruptions

From the data the in Table 18, it is evident that the medical staff from both Egypt and Germany suffers from disruption in the workplace that hinder the proper functioning of the medical processes. However, the root causes differ in both countries; in Germany the causes are mainly due to the thin walls between the rooms, while in Egypt the overall disorganization and external noises are the main cause. This result in less work output and also lowers the quality of such output.

Table 19: category of staff's comments –Privacy.

Staff's comments in Germany	Category	Staff's comments in Egypt
<ul style="list-style-type: none"> Private offices would be better. 	Privacy	<ul style="list-style-type: none"> A private workplace, would be better in order to analyze patient data and files

From the comments above, it is apparent that the medical staff from both Egypt and Germany require more privacy in their workplace, and this is due to the fact that the modern medical environments provide so little or no privacy at all to the staff. The absence of privacy lessens the amount of concentration due to the distractions surrounding the staff; therefore less work output can be accomplished and the quality of work would be reduced. As such, more private spaces need to be available for the medical staff.

Table 20: category of staff's comments –Cleanliness/Hygiene

Staff's comments in Germany	Category	Staff's comments in Egypt
	Cleanliness/ Hygiene	<ul style="list-style-type: none"> ▪ Praxis ist gut ausgestattet und sauber ▪ The practice is well furnished and equipped, and clean. ▪ große Sauberkeit. ▪ The highlight of this practice, is its hygiene and cleanliness ▪ The practice is spotlessly clean.

In Table 20, there are no comments from the German staffs recorded regarding cleanliness and hygiene, which already an essential standard in the medical environments in Germany. On the other side, it is an aspect in the medical environments in Egypt, which still needs to be adapted and stressed.

4.4 Patient's Perceptions of the medical Environment

"There are a difference between providing what a patient needs and what a patient wants. It is important not only to satisfy clinical needs, but also to meet psychological expectations. The fact that patient's satisfaction is still regarded as a "new" trend demonstrates that it is still a work in progress and has not achieved enough critical mass to settle in as one of the basic components of patient care" (Malkin, 2002 p. 1).

An important concept for the definition of environmental design research is- if the research does not include exploration of needs from perception of behavioral or emotional responses to the environmental form and phenomena, it is not environmental/design research (Villecco & Brill, 1981). Hence, it was an essential focus of this research to see the environment through the patient's eyes, it is to assess the built environment in relation to the patient's concerns to reduce anxiety and provide a more patient-centered environment. "Several environmental psychology studies offer a clear insight into the effect of the hospital environment on several patient/health outcome factors" (Cortvriend, 2005). However, little had been done to assess patient's satisfaction within the environment of medical practices and outpatient departments in hospitals. This section illustrates the impressions of patients on different aspects of the built environment from case studies.

At the beginning of performing the case studies, semi-structured interviews have been formulated to be conducted with a patient that after they have finished with the doctor and before they leave for homes. This is so as to give the patient adequate time to sense the environment after moving through the different units and rooms in the health care facility. It shall firstly be noted that through the first contacts and endeavors to interview the patients, it has been experienced that the patient prefers to leave the health care facility as soon as possible after completing

visit to the doctor. Secondly, a patient is embarrassed to address his or her feeling to the design of the environment, when another patient or one of the medical staff is nearby. Even to be alone with them in a room in the facility is an additional pressure on the work processes in the facility, which was undesired. Therefore, an anonymous questionnaire is a better method to assume the patient's response to the built environment.

"The environment is perceived and evaluated in an emotional way, by perception-based on impressions we get through sight, hearing and touch and by intellect as well" (Danielsson, 2005). To assess a wide range of perceptions from different patients (different ages, different educational levels, and different social populations), a simple questionnaire has been developed. The questions were structured, but subjective assessment and open-ended comments were sought.

A selection of findings from the questionnaire are classified and illustrated in tables to outline the nature of the respondents of patients and their views on the designed environment in medical practices and ambulatory units in hospitals. By carefully looking at those findings will identify the factors that contribute to satisfaction and contentment when visiting a medical practice or ambulant unit in hospitals.

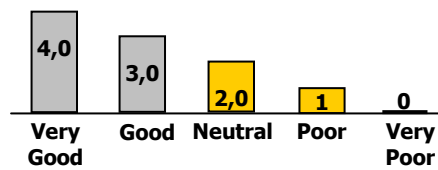
4.4.1 Averages of Patient's Response

So how do patients actually feel about their medical environments? Which aspect or aspect (or aspects) of the medical environment are mattering most to patients? such questions could be first answered through quantitative analysis as in Table 21. The table includes diagrams to illustrate the averages of patient's response towards the different elements and general environment (for the patients included in the cases studied in Germany).

Table 21: Averages of Patient's Response to the different elements and to the general environment (from case studies carried out in Germany).

	Practices						Uni. Hosp. Essen				
	General			Specialized			Pediatric			Surgery	
	Practice A	Practice B	Practice C	Pediatric	Dental	ENT	General	EEG	Ergo therapy	A&E	Neurological
room's Size	2,8	3,3	2,5	3	2,8	2,9	2,9	2,9			3,2
Furniture	2,9	3,2	2,3	2,7	3,2	2,4	2,9	2,7			2,8
Climate	3,1	3,1	3,0	2,8	2,7	2,7	2,9	2,7			3,2
Lighting	3,0	3,1	3,0	3,5	3,1	3,1	2,9	2,7			2,8
Colours	2,9	2,9	2,3	2,7	3,0	2,3	2,4	2,0			2,2
Signage	2,9	3,2	2,9	3,2	3,2	2,8	2,9	2,7			2,9
Art works	3,0	3,1	2,9	3,0	3,3	2,5	2,7	3,0			2,9
Overall the Environment	3,2	3,7	2,6	3,0	3,6	2,8	2,9	2,7			3,4

Patient's Response



The questionnaires would be distributed about 20 to 25 patients in each case. However, as mentioned before in Chapter 3, regarding the cases studied in Egypt it could such a number of patients were not available fore the interview and questionnaire, that because the time span, and therefore it was not possible to calculate a corresponding average response for them. On the other, this number was distributed in Germany in each case study, and it has been able to calculate the average respondent's feeling. However, it will be mentioned to the respondents that the results of the Egyptian patients, while be discussed the results of the German patients, that as discussing all the results of patients included in the case studies in both countries.

An overview on Table 21 provides information regarding the averages of patient's response towards the elements and aspects that shape the medical environment, as well as the response feelings caused by overall environment. The satisfaction levels have been represented on a scale from (0) to (4.0); (0) being the lowest (very poor) and (4) being the highest (very good). All the averages less than level (3,0) (good) are coloured orange.

Generally, it has been noted that it is the category of 'Colours' that is the aspect which has been criticized by patients than any other (it recorded in 8 out of 9 cases less that the level (3.0) (good). In the second stage the category of furniture is noted that it recorded in 7 out of 9 cases less that the level (3.0) (good). As a third the category of the size of the rooms and signage. From this general overview, the categories of colour, furniture, the size of rooms, and signage could be defined as the aspects that have direct affect on the out-patients visiting a medical facility. This is of course in addition to the other aspects as climate and lighting, which shall be also discussed.

4.4.2 Keywords from the Comments made by Patients

Patients carefully analyze which aspects of their experience delight or depress them. Therefore, subjective assessment and open-ended comments were sought. Comments on each aspect and on the environment in general have been noted added by 54% of the patients surveyed in Germany. Those comments shall be discussed momentarily, and shall also be compared to the comments of the patients included in the cases studies conducted in Egypt.

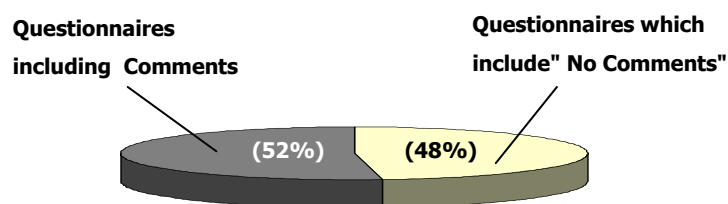


Figure 47: Percentage of the patient's questionnaires which include comments versus those which don't contain comments (taken from case studies performed in Germany).

"Some costs of a poorly designed environment can not be calculated, nor made dramatic and the influences may be great. The aesthetic bleakness is incalculable, but surely significant" (Villicco & Brill, 1981). The medical environments contain features that are considered to yield positive and negative effects in terms of affecting patient's satisfaction. To establish in an in-depth way, what influences of the different aspects in the medical environments have on the patients, and to define their desires, this overview in Table 21 should be deepened through the comments of the patients as suggestions and critic and how many time are keywords emerging in those comments. In the case of each category, the comments have been arranged by

common keywords, as well as by the type of comment (i.e. if it a suggestion to improve the environment, or as a criticism of the environment that surrounds them.

Table 22: Keywords from comments made by patients, suggesting improvements and also criticizing the size of rooms of medical establishments.

Examples from Patients' Comments	Keywords	Frequency of keywords in the comments
Suggestions for improvement		
It could be better if: <ul style="list-style-type: none"> One of the examination rooms was a bit bigger the treatment room were larger the waiting room area was a little bigger the waiting room area were a little bigger the waiting room were bigger the waiting room was bigger the treatment area were larger the rooms were generally bigger the rooms were bigger (as in to accommodate wheelchair users) the rooms could be made bigger 	Larger/ Bigger	***
<ul style="list-style-type: none"> there was another room for examinations there were more rooms there was an extra room for treatment 	More rooms	**
<ul style="list-style-type: none"> the reception were separated from other rooms there was a separate enclosed, waiting room (instead of open plan), would be nice- and warmer too. there was a separate Waiting room 	Separate reception & waiting room	*
Criticism		
<ul style="list-style-type: none"> the waiting room is too small The room where the results are given back is bad, it's too small. the surgery is too small, and not entirely modern 	Too small	*
Keywords Frequency : *≤5, **≤10, ***≤15, ****≤20, *****≤25		

Criticisms noted of the lack of space has been also mentioned in the analysis of the medical staff's comments, and here again in Table 22 the patients included in the case studies in Germany expressed the same remark. The patients included in the case studies in Egypt remarked also to this problem which was not recorded quite so frequently in Germany "More space" as a suggestion to improve the medical environments, is a keyword which has been recorded in the patient's comments more as than 10 times and less than 15 time. This demonstrates how considerable a factor this is, that the patient can experience if there are people and machinery using the space or rooms. This is also the case where more examination and treatment processes in one room when in fact it should be divided in more rooms. The third keyword mentioned, is a desire to have a separated waiting room and reception areas. These would be divided from the exemption and treatment areas, and should be linked for privacy reasons, e.g., if the patient has a feeling that (s)he can be seen by the other patients while the examination or a treatment process are being performed. Similar remarks have been made on this aspect by patients included in the case studies in Egypt. Moreover, when waiting, the patients prefer to have more privacy and to stay away from the corridors, where the other patients come and go. An important keyword which has been time and time again regarding the rooms or also to the medical facility in general, is "Too Small". This all goes to show that more efficient use and a calculated arrangement of space is need when designing medical environments.

Malkin (2002) mentioned the style of furnishings in the medical offices, she mentioned that the furniture must be selected carefully because that will convey an image to the patient about the doctor and his or her medical staff. Yet, Malkin (2002) meant to say that the style of furnishings should not be trendy, because patients need to feel that their doctor is not impulsive, that he or she is a serious person not subject to frivolities and trendy decor. What Malkin (2002) said must be added and compared with the comments of patients, included in the case studies of Germany, regarding the furniture in Table 23.

Table 23: Keywords from comments made by patients, suggesting improvements and also criticizing furniture in medical establishments.

Examples from Patients' Comments	Keywords	Frequency of keywords in the comments
Suggestions for improvement		
<ul style="list-style-type: none"> ▪ It could be better if: ▪ it were more modern, it would make the surgery friendlier. * ▪ moderner ▪ it was more modern ▪ it were a little more cheerful & were more modern * ▪ it were more beautiful & more modern. * 	Modern	**
<ul style="list-style-type: none"> ▪ The chairs in the waiting room were replaced with new ones ▪ some new things were brought in ▪ there was new furniture 	New furniture	*
<ul style="list-style-type: none"> ▪ There were Toys for children ▪ neu und kinderfreundlicher ▪ it were new and more child-friendly ▪ There was child-friendly design ▪ There were things for children to play with ▪ more opportunities for children to play ▪ There were more play-activities for children 	Kids friendly	**
<ul style="list-style-type: none"> ▪ There were more colours ▪ there were friendlier colours ▪ There was more brightly coloured wood ▪ The place was brightly coloured so as to give a good atmosphere for the kids 	Colours	*
<ul style="list-style-type: none"> ▪ more comfortable seating 	Comfortable	*
<ul style="list-style-type: none"> ▪ The chairs in the waiting room were made out of leather, (for hygiene) 	Leather, synthetic	*
<ul style="list-style-type: none"> ▪ there was no plastic furniture 	No plastic furniture	*
Criticism		
<ul style="list-style-type: none"> ▪ it is sterile 	Sterile	*
Keywords Frequency : *≤5, **≤10, ***≤15, ****≤20, *****≤25		

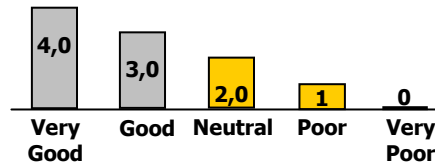
In Table 23 keywords as "modern" and "new furniture" emerged more than 15 times in the patient's comments and often been linked with words such "friendlier" and "cheerful". This demonstrates the need to select modern furniture for the medical facilities as it could give the patients the feeling that the medical staff and technical supplies and methods they use are modern. Here it should be mentioned that the patients included in the case studies in Egypt have not added many comments on the furniture, the quality of the medical service or technical supplies are the main concern to them. In contrast, The German patients stress the importance of adding more opportunities for children to play with and "friendlier" furniture for them, that has been also linked with more colourfully in the medical environments. No comments in this regard, have been annotated from Egyptian patients. In the case studies carried out in Egypt, neither children's furniture nor play-activities for children have been observed. . Other comments mention aspects as comfort and hygiene through the use of material, which principally must be considered and adapted in all the medical environments.

Table 24: Mean temperature levels in waiting and reception areas linked with the middle average of Patient's Response to Climate (case studies performed in Germany).

	Practices						Uni. Hosp. Essen				
	General			Specialized			Pediatric			Surgery	
	Practice A	Practice B	Practice C	Pediatric	Dental	ENT	General	EEG	Ergo therapy	A&E	Neurological
Temperature levels (°C)	22	21	23	25	25	24	19	23	24	22	23
Patient's Respondents Feeling	3,1	3,1	3,0	2,8	2,7	2,7	2,9	2,7			3,2

Notes:

Patient's Respondents Feeling



As seen in Table 24, the most positive average feeling appears to be linked with the temperature average levels from 21 to 23°C, and the negative middle average respondent's feeling appears linked to the temperature levels out of this limit. However, the patient's satisfaction should be considered in more in-depth. The comments of patients in Table 25 demonstrate that more aspects such as the quality of air, for example must be considered. Fresh air is an important need to be ensured of course in addition to adequate temperature levels. Particularly, the Egyptian patients mentioned the need of air conditions in the facilities more frequently.

Table 25: Keywords from comments made by patients, suggesting improvements and also criticizing Climate in medical establishments

Examples from Patients' Comments	Keywords	Frequency of keywords in the comments
Suggestions for improvement		
It could be better if: <ul style="list-style-type: none"> ▪ it were cooler in the summer and warmer in the winter ▪ It was air conditioned ▪ if it was more airconditioned ▪ it were cooler ▪ it were warmer ▪ If it were possible to integrate the airconditioner ▪ i fit were a little warmer 	Air Conditioned	***** **
<ul style="list-style-type: none"> ▪ there were some fresh air ▪ if everything were just a little more fresh ▪ was some more fresh air available 	Fresh air	***
Criticism		
<ul style="list-style-type: none"> ▪ The air's bad. Some fresh air would be nice. 	Poor quality air	*
Keywords Frequency : *≤5, **≤10, ***≤15, ****≤20, *****≤25		

When visiting a medical facility, most patients spend the majority the time the waiting an reception areas. They wait for the start of the examination and treatment processes. They must also wait between the processes (when necessary). In such circumstances, there is a greater opportunity to be affected emotionally with the aspects of lighting and colours. Table 26 illustrates how it could be linked between the illumination levels and the average of the patient's feeling toward the lighting in different medical facilities. Here it must be mentioned, that the patient's response is not only in concern with the illumination levels, but also to the lighting type which is being used in the facility. Yet, it can seen Table 26 that there are more positive respondents toward the daylight. If daylight is not available then the average level of 300 to 400 lux recorded a ":Good" feeling from the respondents also.

Table 26: Illumination levels (measured in lux units) linked with the average of Patient's Response to Lighting.

	Practices						Uni. Hosp. Essen				
	General			Specialized			Pediatric			Surgery	
	Practice A	Practice B	Practice C	Pediatric	Dental	ENT	General	EEG	Ergo	A&E	Neurological
Corridors	170	200	300	460	400	80	400	150	150	300	320
Waiting area	350/ 400	400	300	800/ 1100 D.L.	1200 D.L.	750- 1100 D.L.	450	300	250	500	600
Patient's Respondent s Feeling	3,0	3,1	3,0	3,5	3,1	3,1	2,9	2,7			2,8
<p>Notes:</p> <p>Patient's Response</p> <p>D.L.: Daylight</p>											

As usual in this branch of research, and regarding the approach previously discussed, the comments of patients must be considered in context. Table 27 shows comments made by patients. "More daylight", and "more pleasant", are phrases that have emerged oft in the comments of the German patients, this highlights the importance of the effect of using the daylight on the patients. On the other side, should daylight be unavailable (because of the year season for example), then a type of lighting system must be sought. Neon lighting is undesired from the patients point of view. More modern lighting systems are desired. The illumination levels previously mentioned must still avoid comments such "Brighter" or "Too bright".

Here it must be mentioned that the keywords "Brighter" mostly have been noted by senior patients. Therefore a considerable amount of attention must be given to the particular age group of patients population, who are usually occupy the medial facility.

Table 27: Keywords from comments made by patients, suggesting improvements and also criticizing Lighting in medical establishments.

Examples from Patients' Comments	Keywords	Frequency of keywords in the comments
Suggestions for improvement		
It could be better if: <ul style="list-style-type: none"> More natural daylight could be used Day light were used more, it would be more pleasant. 	Daylight	***
<ul style="list-style-type: none"> keine Neonbeleuchtung no neon lighting were used keine Neonlampen no neon lamps were in place klein Lichter wären besser. Small lights would be better* 	No neon lighting	****
<ul style="list-style-type: none"> moderner Beleuchtung the lighting were more modern 	Modern lighting	*
<ul style="list-style-type: none"> heller it were brighter 	Brighter	****
Criticism		
<ul style="list-style-type: none"> zu Hell it's too bright There's quite a lot of light 	Too bright	*
Keywords Frequency : *≤5, **≤10, ***≤15, ****≤20, *****≤25		

Table 28: Keywords from comments made by patients, suggesting improvements for colours for medical establishments.

Examples from Patients' Comments	Keywords	Frequency of keywords in the comments
Suggestions for improvement		
It could be better if: <ul style="list-style-type: none"> the walls were a little more colourful If the surgery's colour scheme was brighter and more colourful it were designed in a more colourful way there were more colours instead of just white* it were more colourful the colours were more vivid the colours were more colourful and happier there were more colours for children The colours were stronger and more child friendly* 	Colourful, Multicoloured	*****
<ul style="list-style-type: none"> The hue were different, displayed more warmth there were more red it would be warmer there were more warm colours on the walls too were warmer and not so sterile* 	Warm colours	**
<ul style="list-style-type: none"> Instead of the blue, there were pastel colours There were some pastel shades there were more soft shades the colours of the walls were repainted with pastel shades, like the floor here 	Pastel colours	*
<ul style="list-style-type: none"> The colours were friendlier and brighter the colours were brighter The rooms were painted in brighter colours If Could be a little more brightly coloured 	Bright	**
<ul style="list-style-type: none"> it were neutral, simple, white neutral colours were in place, and that would suffice 	Neutral, simple	**
<ul style="list-style-type: none"> the colours were more harmonies and considered in relation to each other 	Harmonious	*
<ul style="list-style-type: none"> The colours were friendlier, brighter* the colours were friendlier the waiting room was painted in a friendlier way there were some friendlier colours, it's too white* the colours on the wall were friendlier 	Friendly	**
<ul style="list-style-type: none"> The colours were more cheerful The colours were friendlier and happier 	Cheerful, Happy	**
Keywords Frequency : *≤5, **≤10, ***≤15, ****≤20, *****≤25		

As mentioned before, colours in the medical environments is an aspect, which has come under criticism from the German patients as against other aspects. That could be also be seen from the high number of patient's comments on colours in the medical facilities included in the case studies performed in Germany. A few comments have been expressed from the Egyptian patients on colour. They indicate that they prefer the white colour in the medical environments as a sign of cleanliness. The same idea has been expressed from the medical staff in Egypt. It should be also mentioned that in one case where the walls were painted with a soft bright green walls colour, the patients in these medical facilities have expressed a positive impression of this colour.

In comparison with comments of German patients, some could define the type of colour they would like. They expressed these colours in keywords as "Colourful", "multicoloured", and "Warm colours", which have emerged often in the patient's comments, the frequency of the keywords could be seen in Table 28. In addition to those types of colour, there are also keywords such "Pastel", "Bright", "Simple", and "Harmonious". The frequency of the keywords in the patient's comments could define the most desire colour type among the patients population of the medical facility. Some patients expressed their desires more simply with keyword as more friendly and happier colour.

Table 29: Keywords from comments made by patients, criticizing existing colours for medical establishments.

Examples from Patients' Comments	Keywords	Frequency of keywords in the comments
Criticism		
<ul style="list-style-type: none"> ▪ Right now, it's too sterile. It could be improved by being more colourful, as it would be friendlier for children. * ▪ not so sterile it would be better if it were warmer* 	sterile	*
<ul style="list-style-type: none"> ▪ The colours are too sobering 	Sober	*
<ul style="list-style-type: none"> ▪ It's boring, and should be replaced with calming colours ▪ It's very boring, The colour must be changed 	Boring / tedious	**
<ul style="list-style-type: none"> ▪ not cheerful enough 	Not cheerfully	*
<ul style="list-style-type: none"> ▪ if the colours were not so clinical, perhaps, and if there were warmer yellows and oranges, for example. * 	Hospital Colours	*
Notes: Keywords Frequency : *≤5, **≤10, ***≤15, ****≤20, *****≤25 *: comment include more as one keyword		

Attention should be given to the comments include and link more as a keyword, as in Table 28 and Table 29 those comments have been added with the sign of (*).

In Egypt and Germany, patients included in the case studies performed in hospitals mentioned more times to the weakness in signage. This has been mentioned from the medial staff also. Wayfinding problems in hospitals are costly and stressful. They have particular impacts on outpatients and visitors, who are often unfamiliar with the hospital and are otherwise stressed and disoriented.

Where no art works have been observed in the environments included in the cases studies conducted in Egypt, the situation in the environments studies in Germany was much more positive. However, the German patients expressed their a desire to have more art works and plants in the medial facilities, as it could be seen from Table 30 some patients mentioned the "Harmony" and consideration the art works in relation to each others. Particular comments for the pediatric medical facilities have been expressed to have more child-friendly motifs in the art works presented in those facilities.

Table 30: Keywords from comments made by patients, suggesting improvements for art works and plants in medical establishments

Examples from Patients' Comments	Keywords	Frequency of keywords in the comments
Suggestions for improvement		
It could be better if: <ul style="list-style-type: none"> ▪ there were a few more flowers around the place ▪ there were some more plants e.g. greenery around ▪ there were flowers ▪ there were more flowers ▪ there were more flowers and pictures ▪ there were more flowers ▪ there was more decoration ▪ there were more brightly coloured flowers* ▪ there were some more of them (flowers and artworks) 	More plants, more art works	* * * * * * * * * *
<ul style="list-style-type: none"> ▪ it were somewhat more brightly coloured ▪ There were colours & pictures ▪ It were a little more colourful 	Colourful	* * *
<ul style="list-style-type: none"> ▪ They were better suited to each other ▪ if all of the pieces were considered in relation to each other 	considered in relation to each piece	* *
<ul style="list-style-type: none"> ▪ there were some motifs around the place for the children, (that they'd recognize) ▪ there were more familiar motifs for the children ▪ mehr Bilder für Kinder hängen 	"Child- friendly" motifs	* * *
Keywords Frequency : * ≤5, ** ≤10, *** ≤15, **** ≤20, ***** ≤25		

Table 31: Keywords from comments made by patients, suggesting improvements and criticisms of their overall impression of the place.

Examples from Patients' Comments	Keywords	Frequency of keywords in the comments
Suggestions for improvement		
It could be better if: <ul style="list-style-type: none"> ▪ It were a little more modern and larger in size ▪ It were more modern ▪ could generally be improved 	More modern	*****
<ul style="list-style-type: none"> ▪ there were new furniture and wall coverings ▪ if it were renovated ▪ the waiting area were renovated as it's badly in need of it ▪ The place was renovated ▪ The waiting area was done-up 	Renovation	*****
<ul style="list-style-type: none"> ▪ If the waiting area was warmer and more nicely designed ▪ If the waiting area were more friendly and cosy 	Friendly cosy	**
<ul style="list-style-type: none"> ▪ It were more orientated to children's needs ▪ there were more opportunities for the children to play in the waiting area ▪ It were more friendly towards children ▪ There were toys for the children ▪ the waiting area was more orientated to children's needs with some things for them to play with would be desirable. ▪ it were more child friendly with regards to furnishings, colours and pictures 	Orientated to children's needs	*****
Criticism		
<ul style="list-style-type: none"> ▪ You're always sitting in the main flow of traffic ▪ The waiting area is always the main walkway 	walkway	**
<ul style="list-style-type: none"> ▪ Everything is very "thrown together" 	thrown together	*
<ul style="list-style-type: none"> ▪ the furnishing is obsolete (old-fashioned) 	obsolete (old-fashioned)	*
<ul style="list-style-type: none"> ▪ the furnishing looks cheap and not modern 	cheap and not modern	*
<ul style="list-style-type: none"> ▪ the waiting areas aren't child-orientated/friendly 	child-orientated/friendly	*
Keywords Frequency : *≤5, **≤10, ***≤15, ****≤20, *****≤25		

"More modern", "Renovation", and "Friendly and Cosy" are all keywords from the patient's comments regarding the overall the environment in medical facilities. That is not in the case of Germany in Egypt too. That in addition to the particular comments form families regarding the environments in the pediatric medical facilities expressing the importance to re-orientate the environments to be more child-friendly.

4.5 Cultural Differences

People react to the environment by sifting impressions through the special filters of their history, memories, and cultural background (Farbstein & Kantrowitz, 1978). Therefore, Dilani (2001) mentions that architecture and design directly affects our minds and senses, but what we consider to be beautiful is dependent on our culture, tastes, knowledge, and background. However, it is not only the design styles but also the structure of the place. When people do similar work, in a similar culture, to accomplish similar jobs, they re-create the same structure to support it (Beyer & Holtzblatt, 1998). That means we should create environments that are more familiar to our background and give more respect to the behavior of the people using them.

From a cultural standpoint, there are many cultural aspects that must be recognized, such as how the people are using the medical environments and how the environment assists its use. Examples of the differences between Egypt and Germany are outlined below:

An Egyptian woman simply will not get undressed in front of a man; also, a man feels similar ashamed too in front of other man. Therefore, each of the examination rooms has a cubicle curtain dividing the examination area from the other side of the room with the physician desk. After (s)he gets undressed and dons a gown, then can the physician enter the examination area.

Also in Egypt, many of the patients, especially the elderly, visit the physician in accompany of two or three persons, from the family or friends. This is due to the need for emotional support provided by the presence of the family. So, the examination room should be increased slightly in size, particularly at the area of the physician's desk, and with the addition of the cubicle curtain as a partition.

In Germany, many of the patients, who visited the medical practices and hospitals are foreigners. Often, they have only basic command of the German

language and sometimes they cannot speak it at all. That leads to communication problems. In giving direction, for example, instead of telling the patient to go to the second or third room on the left or right, it is more easy to tell the people to go where the tableau, plant, or mural are.

Another important remark is the work organization and apportionment. In Egypt, the physician is still the main player and the role of the assistance staff is confined more to delivering the supplies and organizing the patients flow. For example, in the most of dental treatment rooms included in the case studies of Egypt, where intensive support and assisting were expected, the physicians have accomplished the treatment procedures by oneself and without an assistance. On the other side in Germany, the assistance staff take a larger part in the accomplishing of the work procedures. The assistances are more qualified, as those in Egypt, and can perform part of the tests and treatments. This difference is being reflected on the space programming and apportionments of the medical equipments and work stations in the rooms. In Egypt the most of the medical equipments are located and concentrated in the physician room. That is not the same situation in Germany, where the work procedures could be carried out in parallel. That relating to the work apportionment among the medical team in the medical facility, including the physician and his or her assistance staff, which is being reflected on the division of the spaces and the places where the equipments and workstations are located.

Another difference is concerned with colour preferences. The most of the medical staff and patients included in the case studies of Egypt expressed the preference of using the white colour in the medical facilities as a sign of cleanness. On the other side, the most of the patients and medical staff included in the case studies of Germany preferred an environment in warm colours, because of their positive emotional effects. This implies that they take cleanness for granted.

4.6 Evaluation of Methods

The methods used during the case studies performed in Egypt and Germany and the analysis processes executed in the course of this research have been established and reinforced based on the following key principles:

Using a combination of qualitative and quantitative methods and tools yields useful information to discover the effects of designed environments on the work processes and the responses of the medical staff and patients. That relating to the different factors and aspects in the medical environments. Furthermore, the data obtained is valid and important to all involved.

The spectrum of methods and tools allow to select those which are appropriate to the sensitive nature of the medical environments and their users. Applied in a proper way, they preserve the integrity of the patients and the medical staff.

The methods used in the case studies and in the analysis process are simple but efficient to be understood and applied by the designers, and they could employ them in their related work. in the future .

A more comprehensive discussion of the methods and the procedure of applying them is presented in Chapter 6.

Chapter 5

Recommendations and Guidelines for Designing medical Environments

5.1 Introduction

Medical environments are an essential element of the healthcare system, whose design requires regulation and a set of basic standards to satisfy the fulfillment of their roles. This chapter reviews and outlines those basic standards, that can be applied to the process of designing medical environments. The intention is that can be adapted and expanded through a wide range of medical environment settings.

Awareness is the ability to experience new knowledge and recognition, and this means opening up to new information and understandings. By focusing attention on certain aspects that work together to compose a medical environmental, we are able to assist in the outcomes of the healthcare system.

Good planning in building a supportive environment is essential. The power of a supportive environment comes from many sources. Paying attention to details in the design that will result in better performance in the execution of work processes.

It also reduces the stress the medical staff faces, and provides patients with an opportunity to enjoy a more tranquil and caring environment, which in turn yields better results both physically and psychologically. At the initiation of the creative process, focus should be directed to a variety of aspects cross-linked by the designer as shown in Figure 48.

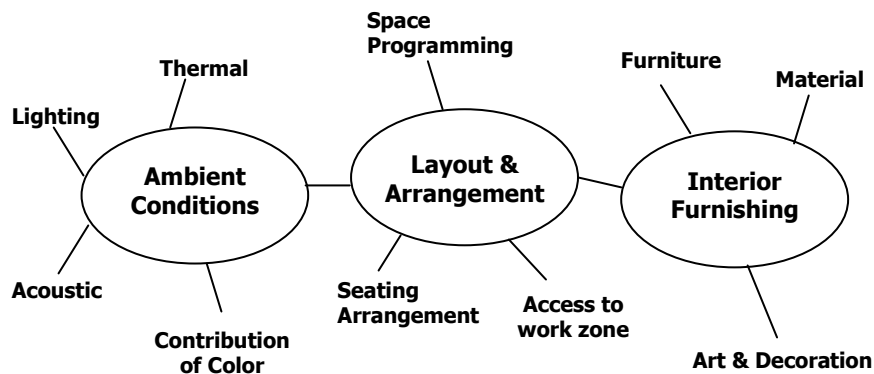


Figure 48: Variety of aspects cross-linked by the designer

"A cross-disciplinary approach is most effective in dealing with environmental problems in a setting and recognizing design solutions to them" (Mahnke, 1996 p. 3).

One of the most significant concerns of this thesis is the cross-disciplinary nature of the aspects supporting the process of designing medical environments, which requires inquiring into a wide variety of resources to serve in clarifying this concern.

5.2 Ambient Conditions

Designers have the responsibility for creating the conditions of the work environment. Modern work environments are constructed to meet various health and safety standards for appropriate thermal, visual, aural, and other conditions, such as the contribution of colour. Hedge (a2005) points out that one of the objectives of proper ergonomic design of the work environment is to create widespread ambient conditions that are comfortable, satisfactory, and do not undermine work performance or health. Starting from the early years of the discipline of ergonomics, it has been shown that the peoples' ability to perform work is strongly linked to the environmental conditions in the workplace. The adaptive physiological mechanisms of the human body allow a person to endure a variety of physical environmental conditions, but often at cost of physical health. When conditions exceed the abilities of the body's adaptive mechanisms, deterioration in performance and health occurs (Hedge, a2005). Figure 49 illustrates the concept of the ergonomics design of the work environment condition. In addition to considering the physical environmental, the emotional aspects of the environmental factors have been thought out in this section also.

Too Cold	Optimal thermal condition	Too Hot
	Optimal indoor Air condition	Too Polluted
Too Dim	Optimal Lighting condition	Too Bright
Too Quiet	Optimal Acoustic condition	Too Noisy

Figure 49: Ergonomic design of the work environment condition (adapted from Hedge, a2005)

5.2.1 Thermal Condition

"We are homoeothermic organisms, and our thermoregulatory system, both physiological and behavioral, allow us to adapt to quite a wide range of climate conditions. We use artificial heat sources, such as fires, and cool sources, such as air conditioning (Hedge, b2005).

Modern approaches to the indoor climate have attempted to specify an acceptable range of conditions for human beings. Temperatures of 19 to 23°C at relative humidities between 40 and 70 percent (preferably 50 to 60 percent) are recommended for sedentary work. That is reinforced by results of the case studies performed in Germany, where 21 degrees centigrade proved to be the most acceptable temperature to the patients and staff.

Air quality

The patients and staff noted many comments on the air quality. According to Ulrich *et al.* (2004), more than a few studies support the significance of adequate ventilation with good maintenance for ensuring both staff and patient protection in healthcare facilities. Ulrich (2001) mentions that much research indicates that airing and filter structures, that produce ultra clean air in areas such as intensive care, procedure rooms, and acute care units, are very important for reducing occurrence of infection and improving positive outcomes for the patient's health. In addition, a recent study conducted in the wake of the SARS epidemic in China found that isolating SARS cases in wards with good aeration could decrease the viral load of the ward and might be the key to preventing eruption of SARS among healthcare workers. This should be assisted with strict personal protection measures in the separation units (Ulrich *et al.*, 2004).

Moreover, well-conducted research has related the subsequent points to the aspects of air quality and infection rates:

- type of air filter;
- direction of airflow and air pressure;
- air changes per hour in room;
- ventilation system cleaning and maintenance (Ulrich *et al.*, 2004).

5.2.2 Lighting Condition

"Human beings are mainly visual organisms, and it is estimated that as much as 80% of the brain's capability to process information is dedicated to creating our individual visual world. Assuming that we have on the whole corrected vision, the ability to see depends to the light accessible in the environment" (Hedge, a2005).

Problematic aspects of the medical environment, such as inappropriate lighting levels and auditory or visual distractions, strongly affect the medical staff's operational effectiveness, e.g. performing critical tasks such as dispensing medical prescriptions (Ulrich *et al.*, 2004). Therefore, there is no single type of lamp which is applicable to all healthcare facility areas. The lamps and their related aspects of operation must be carefully chosen for their suitability to the tasks being performed by the patient and his attendants (Beck, 1978). The lamps should be selected secondarily by their aesthetic affect in the place and the activities occurring in that place. Last but not least, lamps should be selected by their cost effectiveness.

The optimal solution for lighting the locations, which in require proper lighting, is a system of adjustable light levels and tints that can be altered depending on the amount of natural light entering the given environment.

Light does not create space, but it influences our perception of space. It influences our wellbeing as well as our vision. It has been proved that in any giving setting, the light should be considered as a quality and quantity factor. That could

affect the creativity potentials of the environment involved (McCoy & Evans, 2002) (cited in Danielsson, 2005).

5.2.2.1 The Quantity of Light: The Visibility

Adequate attention should be paid to the essentials of visibility in the first place. This should come before considering the social and technological context of the visual environment. Nowadays, factors that affect good visibility are the same today as they were in 1900. These factors are: visual size; luminance contrast; colour differences; retinal image quality; and retinal illumination (Rea & Boyce, 2005). In medical environments, the key for particular functions is sufficient lighting. Therefore, it would not be appropriate to have variations in lighting, for example, of the examination rooms, the consultation rooms, reception and waiting areas (Hosking & Haggard, 1999). The task in the medical facilities may be a very critical one as in a surgical operation or non-critical as in those of housekeeping. Yet housekeeping is as relevant as a surgical operation, as poor housekeeping may result in infection and vitiate the most meticulously performed operation (Beck, 1978).

Adequate ergonomic design of illuminated environments require the contemplation of a variety of factors that are far beyond quantification of the amount of light. It requires that factors which impact our capacity to work successfully under artificial lighting to be carefully considered and calculated (Hedge, 2005). Malkin (2002) states in this regard:

*“Worse than not enough light is too much light. More is not better”
says Malkin (2002 p. 549).*

General recommendation for lighting is as in follows:

- Today's low interior light standards focus on power protection and visual ease, this makes today's recommended interior light levels 100 lux for homes, 300 for classrooms and computer stations to 500 lux for offices (Mead, 2004).
- It is a fact that a 60 year old needs twice to three times as much light as a 20 year old. That should be considered relating to patients populations of the medical facility (Donnerbauer, 2004).
- There are requirements for emergency lighting where loss of light would create special risks (Leighton, 1997).
- The colour of the light is also a factor that must be considered when dealing with visibility issues, for example, the eye can see best in white, yellowish, or yellowish green light and worst in blue light (Birren, 1961).
- Outdoor light levels are desirable whenever possible, as they have constructive emotional and psychological effects. However, outdoor lighting has an adverse side effect of causing headaches, due to the glare involved (Mead, 2004).

More specific recommendations for the medical facilities are presented by Malkin (2002) as following:

- Indirect light sources are desired in the examination rooms as they conceal the lamps and this is helpful in particular when the patients are lying down and looking upwards.
- The examination rooms and nurse's stations require a greater amount of light of 1000 lux. A portable light source should be made available to physicians who require more than this.
- Waiting rooms require a lower level of lighting of 300-500 lux, focused to where people are reading and could be in the form of indirect down lights, as opposed to a homogenous distribution of the light.
- Corridors require a low level of lighting also (approx. 200 lux), and not just from above, as wall-mounted lights convey the colour value and the finish of the interior more accurately.
- The consultation room requires approximately 500 lux of light concerted over the desk.
- Most minor surgery rooms require even more lighting (approx. 1000-1500 lux), through ceiling-mounted high-intensity surgical light in order to optimize the execution of operations. Certain specializations, (ophthalmology refraction, radiology, for example) have particular requirements also.

5.2.2.2 The Quality of Light: Lighting as a Feel-good Factor

The interaction between emotional effect of light and design has been long and abundant. Ancient temple design tracked solar movement to worship sun gods, mark time, and dramatize rituals. Some of Roman and Renaissance architects have written about window placement to maximize light and warm up interiors. The positive effect of light on health was also known since the dawn of modern architecture, starting from when Frank Lloyd Wright and Le Corbusier began promoting the healthy qualities of light and air. In the mid 1970s, energy conservation and building practices further restricted light and window use in buildings (Mead, 2004). Modern light fittings don't just save energy, they also contribute to a sense of wellbeing, and its meaning is ever more increasing in our lives. In hospitals, homes for the elderly, and also medical offices, high-quality lighting can add a more helpful sentiment, a soothing effect, a heightened sense of security and comfort, which positively influences the healing process (Donnerbauer, 2004).

Negative comments on fluorescent lighting have been noted by patients included in the case studies. Malkin (2002) explains this further, she mentions that poor illumination is quite a normal occurrence in waiting areas. All fluorescent lamps (tubes) are coated with phosphors that show a certain range of the visible colour spectrum. Cool white is high in the blue-green range and thus produces a blue or "cold" mirror image on all surfaces, including skin tone. A poorly illuminated waiting room makes it uneasy to read, as well as subliminally propose to patients that the staff is trying to conceal something like poor housekeeping, perhaps (Malkin, 2002).

Most importantly, the patient's expectations of a homely welcoming light have to be met. For them, the anxiety can begin even in the entrance area. Thus, Donnerbauer (2004) stresses that:

“A harmonious lighting atmosphere adds a pleasant atmosphere, a calming and inviting effect” (Donnerbauer 2004 p. 41).

Ulrich states in this regard:

“Using light as an intervention to reduce depression in clinically depressed as well as non-depressed patients is a relatively inexpensive intervention that has been shown to yield consistently positive results.” (Ulrich et al., 2004).

Many different moods can be created by individual illumination (Sieger & Sieger, 2004). In addition, it can counteract dull grey autumn days, when low atmospheric pressure is prevalent. On the other side, the wrong light can increase such an effect of autumn days.

The emotional effect of the lighting system should not only be considered with the patient in mind, but also from the side of the medical staff. Comparatively, they spend much more time in this work environment. Most comments made by medical staff included in the case studies for this work expressed a desire to have more modern light systems which could be controlled in relation to the daylight available. Lighting makes one feel better and full of energy. In the case of operation theatres and examination rooms, lighting conditions should also be improved, as doctors and care staff should also feel well. In this regard good lighting minimizes mistakes and increases motivation.

Good lighting supports an architecturally homogenous unit, thus achieving a pleasing ambience. The superiority and temperament of lighting will add to the perception of the well-executed arrangement of space. One can spend a significant figure sum of money on interior design in terms furniture. However, if the lighting is

rather standard throughout the building and applied in a one-size-fits-all manner, the overall quality and end effect will be compromised. Moreover, the furniture placement can be oriented so that the eyes are directed towards the outside part and not into the dark interior section (Mead, 2004).

5.2.3 Contribution of Colour

Colour is significant because it is a powerful language that affects not only our mental condition, mood, and perception of time, but also our perception of volume, shape, space, and perspective. The proportion of one colour to another and their relationship also alters our awareness of them (Hosking & Haggard, 1999). It is a means of communicating with people, and it provides information. Communication when successful is a transfer of meaning, in this way colours can provide indications, orientations, landmarks, and bearings too. Colour plays a significant role in our health and feelings of well-being (Graham, 1978).

The difficulty in testing for colour preference rests in the inability to control the numerous variables involved. Colour preferences build up as a response to cultural background, educational background, experience, and genetics inherited. In consequence, it has been hypothesized that there is an association between a person's colour responses and his or her emotional status. For that reason, any study of colour preference on "normal" individuals must be based on large samples, so that personality biases due to highly private experiences do not prejudice the results of cultural colour preferences (Malkin, 2002).

5.2.3.1 Psychological Responses to Colour

Emotional assessment of colour is connected to time, place, culture, nationality, age, fashion, and even gender. Colours summon highly personal images and denotations, thus making it complicated to predict and understand the preferences of many. Thus,

many conclusions on the effect of colour and its link to emotional patterns have been disseminated. Malkin (2002) mentions a few of certain practical deployments of colour psychology in design:

“Reds and yellow, for example, should be used in settings where creative activity is desired; greens and blues in areas that require more quiet and extended concentration. Cool colours should be used in the surroundings of the highly agitated, hypertensive, and anxious; red, in the depressive’s environment. Highly saturated colours should be avoided with autistic schizophrenics, as should red with those afflicted with organic brain disease” (Malikn, 2002).

The deployment options are virtually limitless; the information regarding colour preference and practice can be employed in cultural liaisons and trade with foreign countries. Knowing which colours are taboo and which carry religious or symbolic associations in each country is obligatory for extended marketing and trade relations.

Moving to the healthcare facilities with their strange surroundings, in comparison with the home area, gives a big change for patients. For a person admitted to a hospital, colour and material offer the feelings of autonomy and functionality as well as competency and hope (Monz & Monz, 2001).

The goal of effectual colour function in the healthcare settings is to augment the built setting with the apt use of the complete colour spectrum. Research has shown that warm, muted colours can reduce stress while bold colours can increase stress when used improperly in the built setting (Stouffer, 2001).

“Persons of the “warm colour type” supposedly meet the external world with warm feeling; those of the “cold colour type” are closed off

from their surrounding and inwardly integrated” (Malkin, 2002 p. 521).

The German patients included in the case studies expressed considerable criticism to the colours used in the medical environments in question. They expressed also a desire for warm colours in the medical facilities. This should be noted. If it is known that “warm” colours come into view as beneficial requirements of community interrelations, and “cool” colours actually encouraged introspection and meditation (Hosking & Haggard, 1999), then we can begin to design medical environments with the needs of the patients in mind. Therefore, it is imperative that the colour is related to function (where possible) and to consciously utilize strong colours only where their stimulating effects are suitable (Graham, 1978).

5.2.3.2 Functional Colour

The term “functional Colour” is typically applied to uses and application of colour hue in which attractiveness or form are secondary to the more practical purposes; where colour may be employed to aid visual acuteness. This connotation is chief in the field of healthcare facilities design, e.g., in hospital surgery rooms. It is understandable that high-quality vision must be served, not the likes and dislikes of those involved (Birren, 1961).

Birren (1961) noted that some lighting engineers may without restraint suggest white and off-white colour for working surroundings to gain much light as possible per watt consumed. Yet the bright environment is quite unpleasant. White walls do close the pupil, thus hardening vision and serve as an annoying distraction. For the sake of 5 or 10 per cent increase in lighting efficiency, there may a drop of 25 per cent or more in human visual competence. Where a working environment may have dark floors, dark equipment, or dark material, the wall colours must be soft in comparison to correct the condition visually. Operating theatres are conventionally

green in colour because in the colour spectrum green is the opposite of red as blood is red. Blood and other fluids are “shiny”, so exterior surfaces should be matt and never glossy. Green therefore offers the eye relief, but there are many kinds of green and other subtle variants in design which can also be presented (Hosking & Haggard, 1999).

5.2.3.3 Colour Harmony

One clarifying account on colour harmony has been written by the critic Ernst Gombrich in his 1995 classic study "The Story of Art" (Phaidon):

“Anybody who has ever tried to arrange a bunch of flowers, to shuffle and shift the colours, to add a little here or take away there, has experienced this strange sensation of balancing forms and colour without being able to tell exactly what kind of harmony he is trying to achieve. We just feel that a patch of red here may make all the difference, or this blue is alright by itself but does not “go” with the others, and suddenly a little stem of green leaves may seem to make it all come “right”. “Don’t touch it any more” we exclaim now, it’s perfect” (cited in Hosking & Haggard, 1999 p. 123).

Based on the above, the walls and the elements in the medical environment necessitate this meaning of colour harmony. It must simultaneously combine the required information with a kind of visual harmony. Such information could be, for example, whether we are occupying the exam room, reception area, or waiting for a doctor. At the same time it must provide a suitable harmony, that works on a subconscious level. Harmony of the colours used in the medical environments was an important comment from the patients included in the case studies performed in

Germany. It should be linked with the fact that surroundings with harmonious and cheerful colours can reduce stress (Dilani, 2001).

Malkin (2002) comments on the harmony of colour:

“Colour harmony is not just a function of the relationship of hues but depends on largely on the quantity of colour, the intensity, balance, and weight. Certain colour combinations create tension or movement. The goal of colour is not always harmony; some times it is used to excite, stimulate, manipulate, create tension, or expand or contract a space” (Malkin 2002 p. 522).

5.2.3.4 Sensitivity to Light and Colour

Colour is visible only in the existence of light. Colour does not therefore stand for constant values since light affects the nature of the colour, and light itself is not of unvarying quality. It is therefore imperative to comprehend that the tint and shades of many colours need to be used with an awareness. They must be chosen in consideration of the light of different times at the day, and in the artificial lighting used and under which they are to be seen (Hosking & Haggard, 1999). For example, sufficient sunlight with natural wood tones and an accurate percentage and balance of vivid colours creates a warm, interesting environment (Stouffer, 2001).

The greatest values (of brightness) and the warm active colours (such as yellows, reds, and oranges) should be placed in the center of attention. Lower values (of brightness) and cool unsaturated colours (such as dark greens, dark blues, and dark browns) should appear on the side-line of the visual field. This knowledge is mostly significant for the design of graphic signage, advertisements, big paintings, exhibitions, demonstrations, as well as interior design. One may guide people from

one room to another by the skillful display of successive values and colours (Malkin, 2002).

The concept of consecutive contrast and afterimage is very important for interior design. A perception of this notion dissuade a designer from creating disagreeable colour relationships. To that Malkin (2002) mentions that, when the eye becomes accustomed to the significance and colour in an environment, this will influence the brightness and colour of what is seen directly thereafter. Malkin derives examples as follows:

- A yellow object on a blue background appears more luminous. This is because it is placed with its complimentary colour.
- When the eye becomes accustomed to a green surface and then looks towards one which is white it will see a magenta afterimage.
- Similarly, when one is exposed to a yellow-coloured environment with incandescent lighting and moves into another space, experience blue afterimages. This is because blue is the compliment of yellow.

5.2.3.5 Colour and the Perception of Space

The use of colour in the space system design is essential in order to providing visual stimulation, volume enhancement, and in facilitating mood creation to alleviate the repetitiveness of extended confinement. Colour schemes should be designed in relation to room volume and function and the preferred behavioral characteristics (Hosking & Haggard, 1999). The various aspects of awareness previously discussed can be interpreted into the following recommendations and guidelines:

- The entry passage into a new room should be painted in the complimentary colour to the last, so as to visually “prepare” the person (Malkin, 2002).
- Bright objects appear larger than they actually are. Yellow appears the largest, then white, red, blue and last of all, black. A light coloured object can appear larger by placing it in contrast with a dark background, and vice versa with a dark colour on a light background (Malkin, 2002).

- A wall with a window should be lighted so that it doesn't contrast with daylight. High contrast results in eye-strain for the people in the room (Malkin, 2002).
- When each room is given its own colour concept, especially with fresh colours such as blue, green, and orange, the general aspect should be characterized and the special highlights should be realized (Sieger & Sieger, 2004).
- Supportive environments colour and illumination should play a critical role in organizing the space so that its function and other information are clearly understood (Graham, 1978).

5.2.4 Acoustic Conditions

Our ability to hear sounds is significant to many of our behaviors. Seldom are our surroundings devoid of sound. We use sound in the form of verbal communication to converse, listen to music to influence our emotional state, and we use also sound to warn others of imminent danger. Not all sounds are pleasing, and a sizable part of the workforce is exposed to noise. When this noise is erratic, it can have a serious unfavorable impact on our work performance and well-being (Hedge, a2005). It has been observed in the case studies that most of the noise sources are coming from outside of the work environments. However, to control the noise which could happen in the medical environments, a standard suspended acoustic ceiling works well. An example measure for reducing the acoustic level can be by changing the ceiling tiles from sound-reflecting to sound absorbing tiles (Ulrich *et al.*, 2004)

Much research has examined the effects of unwanted noise on patients, but relatively few studies are available for the healthcare staff side and the effect of unwanted noise on them and on their operational effectiveness. However, there is evidence that shows that staff recognizes higher sound levels as stressful (Ulrich *et*

al., 2004). Floor materials should be also considered relating to the sources of noise. In addition, there are other noise sources relating to the activities of the medical staff, the communication distance between them, their moving from one place to another, and opening and closing doors. Towards solving these problems, Ulrich and his colleagues (2004) mentioned that studies of the effectiveness of noise-reduction measures suggest that environmental or design interventions are more successful than organizational interventions, such as staff education or establishing quiet hours in hospitals.

5.3 Layout and Arrangement of workspaces

In the case studies performed in Germany it has been noted that all the medical practices included are rented offices, which were in fact originally intended for other purposes. Even the studies performed in the hospitals of the university, most examination and treatment rooms included in the studies are intended originally for other use. The situation in Egypt is not much better, most of the medical office are spaces for other use than medical practices. In hospitals and medical centers included in the case studies in Egypt, the available spaces and rooms are often less than that what is truly required. Both the medical staff and patient included in the case studies expressed several ideas on the value of space and that more space is needed. This scarcity of space become more problematic the fact that the layout is the most fixed aspect of the design. The layout dominates all other aspects of the physical environment, as it sets the framework for other physical features. Therefore, more efforts are needed to attain efficient medical spaces for the end-use.

The result of the case studies demonstrated that the doctors and their assistants are subjected to various kinds of pain at the end of the work day. As an example, assistants spend a lot of time walking in order to deliver the supplies and patient's

files. Therefore, they suffer more from foot pain than others staff members. According to Ulrich *et al.* (2004) one study shows that almost 28.9 percent of nursing staff time, in hospitals, was spent walking. This came second only to patient-care activities, which accounted for 56.9 percent of observed behavior by nurses. Furthermore Ulrich and colleagues (2004), mention that at least four studies have shown that the type of unit layout (e.g. radial, single corridor, double corridor) influences amount of walking among nursing staff, and two studies showed that reduced walking time was translated into more time spent on patient-care activities and interaction with family members. The environment should be organized for orientation, information, safety, function, and pleasure (Graham, 1978).

5.3.1 Space Programming

Places should be designed with efficiency as a priority. In general the attempt is to attain the highest level of productivity and profit. Therefore, each detail should be planned to minimize efforts of the medical staff and to avoid wasted activities and time. Since the design of the setting can have a foremost effect on performance, effort, and fatigue, efficiency is often an imperative design aim (Farbstein & Kantrowity, 1978).

From an ergonomical point of view, some general design considerations for the laying out of a work space have been presented in Chapter 2. Considerations such as the centralization of the material and tools which will be used by many users, and the maximization of communication between the worker, (see access as example). More specific considerations have been discussed also.

On the practical side, the designer has to outline the total square meter of the facility, and draw up a list of the rooms and their respective. In fact, a smaller space with specific dimensions or a specific configuration may accommodate the processes better than a larger one without such dimensions of suitability (Malkin, 2002).

The methods used in the case studies and in the analysis in Chapter 4 should be applied, in order to determine if there is wasted effort or inefficient use of rooms, to ensure increased productivity. Techniques such as time studies and task analysis strive to eradicate unnecessary actions by reorganizing sequences of action or relocating equipment or places (Farbstein & Kantrowity, 1978). The designer has to answer many questions such as:

- The amount of space need for each group of the processes.
- The type of rooms and areas available.
- The amount of workstation necessary.
- How work process, patients, and supplies should flow through the space.
- What equipment needs to be accommodated.

Schoenwetter (2005) describes an arrangement of a medical practice. For the examination procedures there are two rooms, one where the patient discusses with the doctor and the other one is the private office of the doctor, the two rooms are joined by a closable door. The doctor can easily pass from one room to the next without being noticed by patients at reception. The corner-formed reception area at the entrance links the movement of the people entering and from here can easily be directed in the direction of the doctor's office, in front of which, they're invited to wait on small leather cushions.

Malkin (2002) mentions that in recent years, there has been a tendency towards larger exam rooms as well as wider interior corridors. 275 or 300 cm. would be the goal for the width of a "large" exam room. However, this average of dimensions have been criticized from medical staff included in the case studies performed in Egypt and Germany. They prefer more space in the examination rooms. A wider examination room is required especially in Egypt, because the examination room in most cases is divided into two parts, a consultation part and an examination part located behind a partition.

When it comes to the placement of the registration point, this should be centralized at the main entry area, and it should be able to be helpful in locating other areas at the facility, as well as supporting the examination and treatment rooms.

One of the main components of patient fulfillment is the capability of a patient and their families to effortlessly find their way about in the medical center without getting lost (Malkin, 2002). The arrangements of space can also help; a centrally located workstation that is reachable easily by the patient, and where the staff is always available as well as able to survey and watch a group of patients within a very short walking distance, goes a long way towards making life easier for both the healthcare staff and patients involved. Such a setting enhances communication and contact between staff and patient, thus creating a feeling of security for both.

On the other hand, and relating to the design of wards in hospitals, according to Ulrich *et al.* (2004), the majority of the staff surveyed favored to working in radial units. Hendrich's research (cited in Ulrich *et al.*, 2004) illustrated that decentralized nurse stations decreased staff walking time and increased patient-care time in proportion, particularly when supplies were also decentralized and positioned in close proximity to the nurses' station. Taking this from another point of view, centralized location of supplies certainly could double staff walking times and substantially reduce care time irrespective of whether nurses stations were decentralized or not, as the distance from the supplies is largest by all means (Ulrich *et al.*, 2004). Ulrich and colleagues (2004) summarize this recommendations as follows:

"Design ward layouts and nurses stations should reduce staff walking and fatigue, increase patient care time, and support staff activities such as medication supply, communication, charting, and respite from stress" (Ulrich et al., 2004 p. 27).

Orientation

To reduce the negative stress effects of disorientation and bewilderment, the layout and internal relations between the rooms should be easily understandable and should be logical. The layout of the space determines the sight directions and thereby directs the visual conditions. It affects the borders of space access to windows thus to view some natural elements which are situated outdoors and in natural daylight. Accordingly, the plan layout should enhance imaginative thoughts, as it can support or inhibit visual distractions or communication with the co-worker.

To help with orientation and contain the persons dealing with the space, the designer should avoid high arrangements of flowers and garnishing on furniture in the entry; these items block the clear line of vision to the space beyond as well as to interpreters and other people in the room. The person entering has to be able to maintain eye contact with the registration point (Leibrock, 2000).

Signage systems

Signage elements that help orientate individuals in unfamiliar territory can help to create a greater sense of control and empowerment. Signage systems should be available to enable the patients and their families to alter and add information easily and quickly. They are worth the investment. It is very easy to make people feel hesitant and uncomfortable from the first moment they enter a facility: signposting gives people an opportunity to achieve comfort and confidence (Hosking & Haggard, 1999). The signposts should be clear, accessible, and logically organized.

5.3.2 Access to Work Zone

Examination and treatment are the main tasks in the most ambulatory care facilities. The results of the case studies demonstrate that the design of many exam rooms did not allow neither physician nor other staff members access to the examination table

from all the sides that need to be accessed. The real meaning here is that medical staff should have ample space to access and to move around the exam zone. Every zone where persons work shall have sufficient floor area, height, and unoccupied space for purposes of health, safety, and welfare (Leighton, 1997)

The other matter to note here is that workstations and the workplace generally have to be designed to be used by different staff members as example, for both right and left handed people. Seating and footrests have to be provided and adapted to the individual in the particular spot. Poorly designed workplaces which ignore good ergonomics can lead to problems, especially where work is repetitive. Every work station shall be so arranged that it is suitable both for any person at work in the workplace who is likely to work at the work station and for any work the undertaking of which is likely to be done there (cited in Leighton, 1997).

5.3.3 Seating Arrangement

As discussed in Chapter 4, communication between patients and staff members is an essential activity which takes place in medical environments. When it comes to face-to-face communication, most of our central activities involve communicating or interacting with other people, talking, listening, touching, or changing things. The settings where these exchanges occur have extensive impact on the value and helpfulness of the communication. Environmental aspects along with behavioral factors affect people's interactions significantly. These are distance, lighting, acoustics, furniture arrangement, as well as people's roles, values, interests, attitudes, and intentions, all important components of any communication type (Farbstein & Kantrowitz, 1978).

The character of the interaction depends on the relationship between the people and the nature of what they are communicating. The communication between the medical staff member and the patient is more often than not two-way, as each person

is sending and receiving information, while in large groups communication is predominantly one-way. Communication is also an important indicator of satisfaction. People will talk to others who are in close proximity when they are satisfied. So, a closed, sliding glass window with a buzzer for service tells patients that they are not really at home and that they are interfering with the staff's privacy. The space and barriers express disregard to the visitor. Therefore it is good practice that the receptionist should always be in view of patients and accessible to them (Malkin, 2002)

Desirable distance

Distance affects the functioning of communication. At times interaction involves the exchange of physical objects and occurs in settings which are specifically designed to accommodate, e.g., interaction with the receptionist or with the physician. One of the reasons patients feel intimidated may be due to the perceived status difference between the physician or technician and themselves. For instance, the patient sits in a powerless position while being acted upon by others; feelings of helplessness are decreased when the physician provides rapport and makes eye contact with patients, which most often is far from happening. This rapport building can be made possible by the layout of the examination room and the way it is furnished. Maybe by a pleasant corner where physician and patient could face each other while sensing protected from the sides behind (Malkin, 2002). The question always to be asked is: did the settings support the interaction effectively or did they hinder it, instead?

In Table 32, Hall (1966) defined the usual distances for major kinds of communication:

Table 32: Communication distances

Communication type	Distance
Intimate	Contact to 45 cm
Personal	45 to 120 cm
Social	120 to 365 cm
Public	365 cm and up

Each distance is characterized by different types of communication and the use of different senses. These distances are not absolute, but vary considerably among individuals and cultures, especially for intimate and personal interactions. Some people feel comfortable being near a stranger at very close distance. Others physically retreat to increase the distance, feeling that their “personal space bubble” has been intruded upon. Each culture has certain unspoken rules which govern the acceptable distances between people interrelating in particular circumstances. As an example for cultural differences, northern Europeans prefer more space between themselves and others than do southern Europeans (Farbstein & Kantrowitz, 1978 p101). If distance rules are broken, discomfort or embarrassment can be the consequence. Americans maintain larger territorial boundaries; an American may maintain an imaginary barrier 60 centimeter in front of him or her as a safe conversational distance with strangers, while a person from the Middle East reduce that safe boundary to 30 centimeter (Malkin, 2002). Here attention must be given in relating the people from the Arabic world, the distance between the same gender could be right about 30 cm, but it should be more if the gender is not the same. Americans do not like to be touched. They appreciate more personal space, maintaining a distance at least of 250 cm from strangers (Leibrock, 2000).

Seating position is also a reflection of the nature of the interaction, as it is a symbol of social position and interactions. There are many kinds of interactions, and the success of any place where these interactions take place depends on its support of the interactions which take place there (Farbstein & Kantrowitz, 1978).

Seating Arrangements in Waiting Rooms

Malkin (2002) points out that seating arrangements in a waiting room designed for Americans should not compel strangers to sit together, as this only increases the stress of visiting the physician or dentist. Yet, in deference to the ethnic diversity that characterizes the American population, flexibility should be available as to allow waiting in family groups as well as offer seating that minimizes communication with strangers, since both options may reduce stress for the widest number of individuals. Individual chairs should be supplied and prearranged so that strangers do not have to face one another with a distance of less than 240 cm amid them. Chairs should be placed against the walls or in configurations that offer an amount of security, so that seated persons do not feel they are in danger of being approached within reach from behind. Careful planning in this regard will assure patient comfort in the waiting experience. Also helpful would be to provide intimate group tables for families (Leibrock, 2000).

Although the importance of the built environment for patient confidentiality may seem self-evident, only a few studies have directly examined the role of unit design or architecture.

How we relate to each other in society influences the method by which we recognize and utilize places. Privacy, status, wealth, and control express social values comprehended by the people who design and manage places. When we divide up places with other people, we may be able to assist or may find ourselves in disagreement (Farbstein & Kantrowity, 1978).

5.3.4 Reducing Infections

It is well-established that the hands of healthcare staff are the principal cause of contact disease transmission from patient to patient (Larson, 1988) (cited in Ulrich *et al.* 2004). One way to increase hand washing is through educational programs and training courses. The second way is by suggesting enhanced medical environmental design which can be effective in elevating hand washing through the effective placement of a number of sinks and alcohol-gel dispensers in prime locations. Unfortunately, several sinks in the medical environments are placed in comparatively inaccessible or inconvenient locations, such as behind doors or far from the staff work paths. In regards to the latter, Ulrich and colleagues (2004) identified six studies that examined whether hand washing is improved by increasing the ratio of the number of sinks or hand-cleaner dispensers to beds, next to the doors, and/or by placing sinks or hand-cleaner dispensers in more accessible locations. The results showed that, making the facility of proper hand washing more accessible, does actually decrease the amount of infections.

5.4 Interior Furnishing

This section discusses the specifications of interior furnishing items that are particularly suited to medical environments.

Every patient will walk through the medical facility, (s)he will go into the reception area, waiting room, examination and treatment units. The furnishing should establish immediate rapport and put the patient at ease. First impressions are very important. Out-of-date-furniture, worn upholstery, and grimy spots on walls may suggest to the patient that the doctor does not care about patient ease. Or it may subliminally suggest that the doctor is out-of-date on medical matters as well, which can lead to a lack of assurance and breed concerns in the patients' mind (Malkin,

2002). No doubt, it is a serious subject and a well established finding that physicians and their assistants really need to have comfortable and ergonomically designed office furniture. In addition to those both sides, there is the nature of the procedures in the medical facility, which calls for some specific consideration in the using of materials as floor covering and walls and ceilings.

Interior furnishings can reinforce the “identity” of the environment. Interior furnishing is the extra effort and quality that is put into the detail of the environment. Patients and their families evaluate a clinic by small design details and visual impressions. Sensibly designed and maintained, medical practice contribute to humanizing the experience of visiting a medical office. Taking care of the full design detail magnifies the impression of capability. Providing a place for coats, boots, and umbrellas, offering drinking fountains, large print magazine in a lowered rack. The comments made by patients included in the case studies stressed the importance of providing a children’s opportunities, which need to offer area away from the entrance and the door swings and traffic area; all these factors convey care and trustworthiness in any clinic as it is the small things that make all the difference (Leibrock, 2000). Moreover, some specialist environments make particular demands upon a designer, as for instance where in a psychiatric practice the reflection in the mirror should be avoided (Hosking & Haggard, 1999).

5.4.1 Furniture

5.4.1.1 Functionality

There are many companies specializing in the area of furnishing hospitals, healthcare facilities, and offices. Most manufactures offer individual chairs as well as modular. The most of them consider the ergonomics specifications for chairs and

desks. Yet, it has been noted during the case studies, that various design details and elements could affect the use of the environment. As an example, the poor placement of rails and accessories and incorrect furniture heights can increase the incidents of fall off and thus should be avoided. These items should be suitably placed with adequate space beside them to avoid any accidents. Partitions and furniture with legs that extend into traffic areas should be generally avoided. Legs that pose a tripping hazard and can limit access by wheelchair users should also be shunned (Leibrock, 2000).

Many general and specific considerations should be linked with the variations in the patients population of the medical facility. According to Malkin (2002) and Duffy (1997), the following criteria should considered:

- A number of chairs intended for use in a waiting area should have arms. These should not be too low or difficult to get out, and should be balanced so that they won't tip over when someone pushes down on one arm only.
- It is up to the designer to make beautiful the modular seating arrangements, and to use curves whenever possible.
- The variety of patients should be considered. This means providing seating for all kinds of body shapes and other requirements, i.e., some chairs without arms, some high-seating for geriatric patients etc.
- Designing play-areas for children must also be integrated. Providing proper storage for toys may encourage to replace toys after use.
- In cities where rainy weather is prevalent, an area located close to the entrance and within view of the waiting room should be provided, where boots and umbrellas and other outer clothing can be removed and stored.
- A magazine rack should be installed, to deter the disorganization of reading material.

5.4.1.2 Style

There is considerable opportunity for the doctor to express his or her personality and style preferences in furniture and interior design. But most physicians, surgeons in

particular, must carefully select furniture that will convey a solid and conformist image. Patients need to feel that their surgeon is not spontaneous – that he or she is a serious person not subject to unsuitable behavior and up-to-the-minute décor. This is true for oral surgeons as well (Malkin, 2002). The chairs and counter could be specifically designed and built to create a housing atmosphere instead of sterility (Sieger & Sieger, 2004).

Some chairs made out of easy-care linoleum lined up on the smallest possible area of space in order to fit as many patients in as humanly possible are not a good option. Also a disarray of newspapers, magazines, and such certainly reflects the disorder of the place. In most cases the patients do in fact notice these small discrepancies which contribute to making them uncomfortable (Monz & Monz, 2001).

5.4.2 Material

A door that in a residence may be opened and closed 3,000 times a year may be opened and closed 100,000 times in a medical office annually. Similarly, cut pile carpet designed for residential use does not hold up well. It is difficult to clean and may show wear sooner than a commercial carpet. On the other side, sanitation and flammability considerations must not be overlooked (Malkin, 2002). In this sense two types of criteria must be well thought-out regarding the use of material in the medical facilities.

- The Performance factors
- Life Safety Codes and Building Codes. In addition to any other local codes apply to the selection of interior finishes and material for their specific medical or dental project.

Natural surfaces are porous and bacteria-friendly, and don't wash well with detergents. Yet, people prefer natural materials to artificial ones. It's nicer, more tactile, and has a calming effect. Currently in design affairs, the designers aim to let the natural materials visible allover; leather for the sitting cushions, and wood for the backs of the chairs. Therefore, greater use of the artificial coating must be integrated, which provides the hygiene requirements and the appearance of the natural materials. Research specialists in the material work will give the possibility of those material to be ready for use in the hospital (Wettig, 2005)

5.4.2.1 Doors, Windows, and Ceiling

The entrance of the health care facility, and also the waiting room, should have windows or glass doors to allow the patients and their families a view into the reception area while still presenting a layer of fortification before entering the space. The doors should be made of safety glass.

It is important that windows begin in a suitable height off the floor, which enables cabinets to be insulated under them (Malkin 2002). Windows in examination rooms should not extend to the floor, so as not to be compromise the privacy of the patients and retain wall space for storage space and seating. The door swing also should be designed to offer a degree of solitude (Leibrock, 2000).

Ceilings are a space which can be used imaginatively. They are also large surface that is out of reach and can be covered.). A suspended acoustic tile ceiling is more functional than a gypsum board ceiling because it gives access to the electrical and mechanical equipment above it and is easier to clean. Where sanitation is of extreme importance, a plastic-coated acoustic tile or an enameled gypsum board ceiling should be used (Malkin 2002).

5.4.2.2 Flooring Material

The floor is a serious factor which needs to be knowledgeably assessed before plans are made to adjust room use (Hosking & Haggard, 1999). Improving flooring installations as a component of environmental modification programs decreases incidents of falling. Slippery floors, for example, can increase the number of incidents of falling.

According to Malkin (2002), flooring may be carpet, vinyl composition tile (VCT), sheet vinyl, ceramic tile, wood, or a combination of all five. The designer should be aware of the weight-bearing capacity of a floor before deciding on its new purpose (Hosking & Haggard, 1999).

Hard Floor Covering

Ceramic tiles: these are simply clay tiles made of a thickness and fired to a hardness that makes them suitable for floors in high traffic areas in medical facilities and hospitals. They are virtually indestructible but are harsh (Hosking & Haggard, 1999). Highly polished floors and pale gloss enameled walls can pose a grave handicap to the ill and elderly people. Visual distortions must be expected and dealt with by using matte finishes and suitable contrasts (Graham, 1978).

Wooden floors: since wood is natural material, it is preferred and desired by many patients. To evoke the negatively traditional quality of the natural wood, modern woodblocks come in coated sections. They are a good selection, on condition that they are well laid and not subject to water or fluids, as this makes the laminates split and pull away from the paste (Hosking & Haggard, 1999). However, the acoustic aspects should be measured and considered, for example, with regard to the specialization of the health care facility case as in the of ENT practices. Here, carpet floor provides a much-needed acoustic function.

VCT and Vinyl sheet: VCT is very robust, it only needs to be waxed and buffed. Sheet vinyl is recommended in minor surgeries or in places where hygiene is a concern, because it has fewer seams than VCT and may be installed with a self-coved bottom. It can be used where cleanliness is of high importance. There are also sheet vinyl floorings that do not compress under the weight of heavy equipment. Sheet vinyl used in high-traffic areas or where substantial pivoting takes place, such as operating rooms, should have colour that is integral throughout the entire thickness of the material, as opposed to a slim layer of colour laminated to backing material (Malkin, 2002).

Soft Floor Covering

Use of Carpet: carpet progressed for reasons of comfort and it is almost consistently believed that carpeting makes a place homely and welcoming (Hosking & Haggard, 1999). It is not uncommon to find entire medical or dental offices carpeted. Apart from any consideration previously discussed regarding infection control, carpet, if selected appropriately, is easy to preserve and adds warmth to the office look. It provides a much-needed acoustic function as well (Malkin, 2002). According to Ulrich (2001), there are escalating indications that carpet is a superior flooring material from the point of view of certain patient-centered considerations. Elderly patients walk more competently (longer steps, greater speed) and feel more protected on carpet compared to vinyl surfaces. Employees, however, overwhelmingly favored vinyl composition (83%) for the most part because of greater ease in cleaning up spills. It must be added, carpet actually improves indoor air quality by holding on to dust particles, which have otherwise the capacity to become airborne, until vacuum cleaners equipped with environmental airbags remove the dust from the carpet. Antimicrobial treatment inhibits the expansion and reproduction of microorganisms and should be well thought-out for most medical facilities where patients may be highly vulnerable to these agents; allergists' offices,

chemotherapy areas, surgery centers, oral surgery offices, pulmonary specialty clinic (Malkin, 2002).

5.4.3 Art Works and Plants as Positive Distraction

Cintra (2001) cites:

"The arts, as the way we can express our feelings, stories, relationships and connection, have a significant contribution to health care facility design" (Cintra, 2001 p.303).

Art works are only one of the elements of the surroundings which affects the users; people do not usually visit practices or hospitals to see the art works. However, as mentioned in Chapter 4 distraction, by using art work, for example, may or may not be desired in medical environments. This is according to the nature of the clinical procedures that have to be accomplished, and also to which area in the facility this "distraction" opportunity will be added. Positive desired distractions refer to a small set of environmental features or conditions that have been found by research to successfully reduce stress. Distractions can include certain types of music, aquarium, art works, and especially nature (Ulrich, 1991) (cited in Ulrich *et al.*, 2004).

Art now plays a major part in health advertising and healthcare (Senior, 2001). It is principal to bring more art into the medical practices. "More art works" is a keyword noted more times in the comments made by patients included in the case studies. The art works are in the form of photographs, texts, preparatory, sketches, and models; these are valuable – and valued - displays in themselves.

5.4.3.1 How important is art in medical environments

Cintra (2001) states the reasons why art is important in medical environments, in two respects:

- Arts can improve the excellence of the environment. This can be done through facilitating way finding, giving distinctiveness to the place, and providing a compassionate appearance to the environment.
- Arts can improve the emotional feeling of wellbeing through supporting social interaction, endorsing ownership of the place by the users, and promoting social support as well as providing positive distractions.

There are several benefits of providing art works in the medical environments to be more humanized. Such as, to create more attractive places to sit, wait, and work and to help people to feel comfortable in navigating their way around the building (Scher, 2001). By artwork and plants, it could be easier to orientate, recognize, and remember the way around; thus, they are also guidance points.

To that Senior (2001) states in addition:

“When the arts flourishing in a healthcare setting, not only the physical environment changes, but the social environment is tangibly different, and the attitude of those delivering the service changes as their workplace becomes enlivened” (Senior, 2001 p. 83-84).

Bringing more art work into the patient areas, for example, in then waiting area, corridors, and also treatment rooms, must be in line to the needs of doctors and health care staff. Educational exhibits or artwork can be cleverly deployed in a medical environment. The subject matter may provide practical information about the facility or its physicians or history, or explain birth defects, sports injuries, or other medical conditions. Pictures and similar items should be mounted in the environments for children (Malkin, 2002).

Danielsson (2005) mentions a study that has been conducted by Heerwagen and Orians (1990), the study dealt with a windowless Dental Fears Clinic to examine the possible calming effect of artwork. The clinic treated people who have abnormal fears of going to the dentist and were anxious when they come in for treatment. The researchers wanted to see whether a large and nice-looking wall painting with a landscape would be a useful way of reducing the patients' tensions while they were waiting for the dentist. Analysis of the sentimental scales showed that patients felt more soothed and less tense in the mural conditions that were in the plain waiting room. There were also differences in heart rate. Those exposed to the mural conditions developed a smaller increase than those waiting in the plain room. In addition, the artwork, aquariums, and puzzles help to make the office also less threatening to those inside (Leibrock, 2000).

5.4.3.2 Taste and Selectivity

As artworks are very varied in both techniques and content, we must explore if the art that we are recommending for healthcare facilities is in fact creating the results we want (Cintra, 2001). Art should support a sense of easiness and not adding a sense of illness, and this must be a standard for using art in health care environments (Senior, 2001). There is also a confirmation that inappropriate art styles or image subject matter can increase stress and aggravate other outcomes (Ulrich, 1991) (cited in Ulrich *et al.*, 2004). It should not be anticipated that all art is suitable for high-stress healthcare spaces, as art varies very much in subject matter and style, and much art is emotionally challenging or confrontational (Ulrich *et al.*, 2004).

According to Ulrich (2001), the greater majority of patients prefer realistic art depicting scenes of natural environments having scattered trees and/or non turbulent water features. Abstract art, and particularly emotionally challenging or provocative works, are time after time disliked by patients. Ulrich mentions further that

designers, artists, and some medical staff respond positively to abstract or challenging images, yet there is mounting evidence that such content or styles in picture can increase stress and worsen other outcomes in many patients. Caution should be used before exhibiting confusing, challenging art in patient spaces or high-stress waiting and treatment areas. Results of more than a few studies propose a consistent pattern wherein the great majority of patients respond positively to representational nature art, but numerous people react negatively to chaotic abstract art (Ulrich & Gilpin, 2003) (cited in Ulrich *et al.*, 2004).

Ulrich *et al.* (2004) mentioned to a study in a Swedish hospital, which found that heart-surgery patients in intensive care units who were assigned a picture with a landscape scene with trees and water reported less anxiety/stress and needed less strong doses of pain drugs than a control group assigned no pictures. Another group of patients assigned an abstract picture, however, had worsened outcomes compared to the control group. Another well-controlled study of blood donors in a waiting room found that blood pressure and pulse were lesser on days when a wall mounted television displayed a nature videotape, compared to days with continuous daytime television programs (Ulrich, Simons, & Miles, 2003) (cited in Ulrich *et al.*, 2004).

5.4.3.3 Plants and Green

Nature can affect our emotions positively. It can easily catch a person's attention or interest and in turn can stop or reduce anxiety while bringing about desirable psychological changes. It can reduce blood pressure, ease pain and stimulate our senses positively (Dilani, 2001 p. 37).

In the medical environments that have been included in the case studies conducted in Egypt, most settings featured no real nature or artificial plants or

flowers. On the other side, in the medical environments in Germany in each facility were a few installations of plants. However, the German, patients noted to have more of them. That can explained by what Ulrich *et al.* (2004) mentioned, that many studies of populations other than hospital patients have produced strong evidence that even reasonably short encounters with real or artificial nature settings can draw out notable recovery from stress within three minutes to five minutes at most (Parsons & Hartig, 2000; Ulrich, 1999) (cited in Ulrich *et al.*, 2004). That is in regarding the patient's side. The effect on the medical staff will be greater, who spend at least 8 hours daily in the medical environments. Malkin (2002) said that there is no substitute for live green plants in a waiting room. She mentions further that the plastic plants could give the impression that live plants probably could not continue to exist in such environment, and the patient may feel no better. Healthy, lustrous greenery, on the other hand, promotes feeling of well-being.

Stressful or negative emotions, such as fear or anger, could be reduced and emotional and physiological states can be altered by providing the following: a view of nature from waiting areas and staff spaces; an aquarium in a high-stress waiting area; flowers and greenery plants; and calming nature art mounted where it can be viewed by all.

Chapter 6

Creating a Supportive Medical Environment

6.1 Introduction: Supportive Design Defined

If you take a problem to an architect, a building will be result; if you take a problem to a lawyer, action within a legal framework will result. The selection of the discipline itself is implicitly the selection of a problem's solution. But environmental design research examines a problem without a fixed solution bias, welcoming diversity and human or environmental complexity, and offers the potential of both interdisciplinary investigation and interdisciplinary results. Its products range from methods, policies and processes to physical design". (Villicco & Brill, 1981)

In this sense, the methods used to perform the case studies in Egypt and Germany along with the analysis processes used in the course of this research have established that a combination of investigation methods and tools is required and beneficial. That allowed the designer to build an interdisciplinary awareness, enabling to deal with the complexities of the medical environments.

This chapter discusses the nature of the design planning process, which should be supported by the assessment methods and the analysis processes that have been applied and adapted in this research. Those methods are practical and efficient for designers to perceive and to employ and expand upon them in a wide range of medical environment settings.

Thirty years ago, Perin (1973) demonstrated the two following points of view:

- Architects and planners may be heard to ask, "Why are people so stubborn or misguided as not to use the places and spaces we design – either not at all or not in the right way?"
- People may be heard to ask, "why are architects and planners so insensitive in what they put up and expect us to live with? Why do they so often leave out just what we think is so important?"

The result of the case studies demonstrated that the work processes, in the ambulatory unit in hospitals and medical centers and offices, are hindered by the design of the physical environment. The medical staff is suffering from various kinds of stress, aches, and pain sources, and various aspects (and elements) of the environment have been criticized by the patients and medical staff, that they are not satisfied with or within the designed medical environments.

Hosking & Haggard (1999) say that small clinics or offices may require improvements that can be supplied without any structural alterations but just redecoration and rearrangement of furniture and equipment. However, wide structural alterations are not possible usually. Then, the successful supportive design of an ambulatory care facility needs more effort from the designer to attain the best use of the space available, under the structure's limitations. This is say, the design of the environment must support the work processes of the medical staff group (and the particular characteristics of their work) and also respecting the accustomed manner in which they are performing their tasks.

Although, a medical facility is a place the patients are unaccustomed to. It must meet their needs in order to accommodate the risk group to which they belong – inner city or rural, young or old, mostly well or acutely ill (Leibrock, 2000). The term supportive here refers to environmental characteristics that not only support or facilitate the needs of the patients and medical staff, but also to support the communications between them. The designers in the field of environmental design bear a greater responsibility. Supportive environmental design may have strong multiplier effects. Its result can profoundly affect how people work, collaborate, and feel (Villecco & Brill, 1981). The integrated concept of supportive design is illustrated in Figure 50.

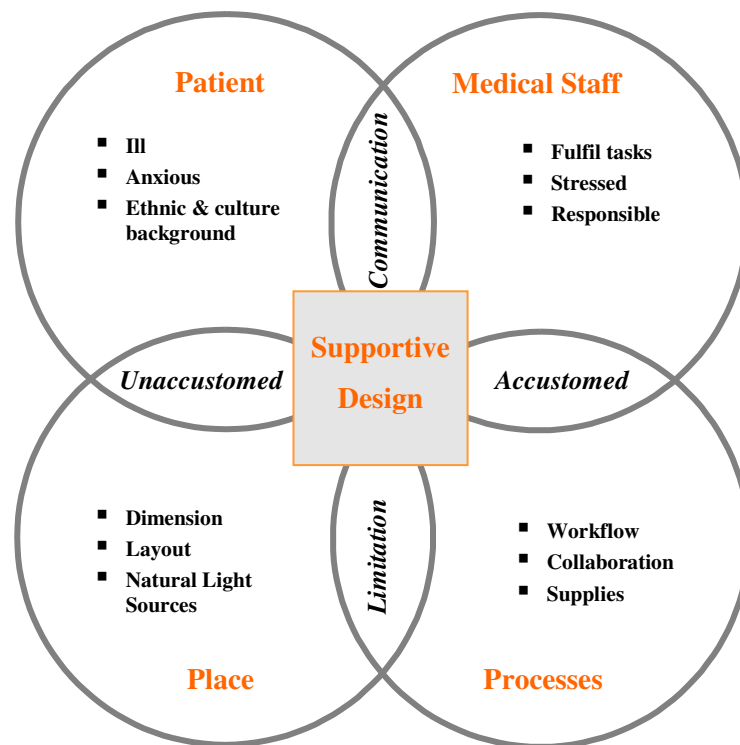


Figure 50: An integrated model for defining the approach of supportive design for the medical environment.

The similarity between the practice of medicine and the practice of design appears, some times, superficial. But in fact they are more intimately related than may be superficially apparent. Hamilton (2003) says that (cited in Ulrich *et al.* 2004) just as medicine has increasingly moved toward “evidence-based medicine” where clinical choices are informed by research, healthcare design is increasingly guided by research linking the physical environment of hospitals to patients and staff outcomes and is moving towards “evidence-based design”.

Regarding the concept of Evidence-based Design (EBD), Ulrich and colleagues (2004) mention a process for creating healthcare facilities, informed by the best available evidence. They mean by EBD not only nicer decorative medical facilities and hospital. Rather, the focus of evidence-based design is to create environments that are seriously supportive to patients and staff, and facilitate the performing of the work processes. Related to this concept there are two facts:

- First, facilities cannot be designed if the functions to be housed are not known (Jones, 1994).
- Second, it is the job of designers to listen carefully and uncover the meaning of the messages they hear (Hosking & Haggard, 1999).

Environmental assessment methods and tools, for investigation in the existing medical environments, must be defined, and the processes in analyzing the data achieved in the investigation phase should be developed. Those methods and processes are discussed in the second section of this chapter.

6.2 An Overview of the Structure of the Design Process

Dilani (1999) says that the design theory concepts and models are typical fields for most modern design research. In those research, efforts are being invested to develop concepts and models, which are as general as possible. Design theory is a collection of theories and concepts about and for the design development of objects, i.e.,

artificial things and systems. However, Dilani (1999) mentions further, design theory is not a cohesive and consistent entity, but rather conceptual framework concerning the basic issues of design and development work.

On the other side, and relating to the nature of the environmental design, Perin (1973) mentions the experimental model in design, pointing out that the experimental model does assure the delineation of gross effects – where the physical situation is gross and the human response is as well, then visible or readily human response levels will be measurable. But usually, in the process of designing an environments the largest effects, if looked for, are relatively easy to foresee. However, Perin (1973) mentions further that the effects are not anticipated and not intended are those which cause difficulties over time. There are many of them, and intuitive sympathy may not be adequate for perceiving them.

Hence, it is important to include case studies of real situations and/or projects in the design research. Attention must be given that by studying cases, methods used and results should be systematized to contribute to the developing of design processes. The formal description of the design process has been driven by Maver (1973) as following:

"The design process is distinguished as an interactive and cyclic activity involving analysis, synthesis, appraisal, and decision"
(Maver, 1973 p. 195).

Dilani (1999) mentioned that the ASED model (analysis, synthesis, evaluation, and decision) became established in the 1960s as a commonly accepted basic model for all forms of design and development work.

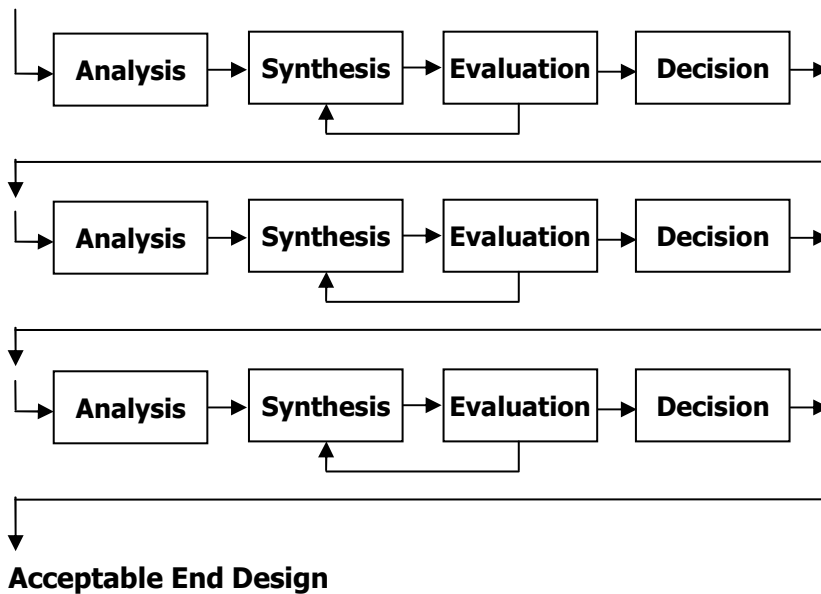
Design Brief (Problem)

Figure 51: The ASED Model (adapted from Dilani, 1999; Maver, 1973)

In the analysis stage, information is collected and re-formulated into design criteria. The synthesis stage consists of the creation of sub-solutions and proposals corresponding to a sub-system of criteria. The evaluation stage consists of a test how well the sub-systems of criteria and sub-solution have been matched. This is followed by a decision from the commissioner/client and design team about how to realize the design proposal (Dilani, 1999). This cycle of design activities seems to include all subdivisions that various designers attribute to their work processes, sometimes the stages merge into each other, and sometimes complex combinations are used (Ward, 1973).

In the conception phase of a new medical environment, as designers engage in the process at their drawing boards or on their computers, the process should include

making use of the guidelines and recommendations which have been discussed in Chapter 5, and of aesthetic criteria. The process makes use as well of the personal characteristics and attributes of the individual designer, such as his gifts and training in creating form, his ability to empathize with people outside of his immediate experience, and his prejudices, biases, and values. This phase and its components of the design process are individual from one designer to other designer, and that could be investigated in other research. Now what is to be discussed here, is the inception phase of the design process. This is where the designer defines and determines the data which is translatable to plan and form. The mediator phase between inception and conception is the design program for the environment (Perin, 1973), which ideally sets forth in analyzing, categorizing, and writing all of the tasks and activities to be housed, needs and desires of both patients and medical staff to be satisfied.

6.2.1 The inception Process in Environmental Design

There is no doubt of the need for closing the gap between what the designer does to make and change the medical environment and what medical staff and patients need from their environment. Perin (1973) summarizes this as follows:

"why it is needed and what it is to do for the people who will inhabit it" (Perin, 1973 p. 59).

The approach proposed in this research is the design strategy where first the designer is bridging between several disciplines to built interdisciplinary vision and design considerations. Secondly, they should mix the use of instruments to determine what staff and patients currently do (regarding work processes) and what exactly they need in their new environment.

The design programming should start with the mission of the facility, outlining the overall goals, functional objectives, and qualitative and quantitative information.

That is a collection of accurate and detailed data. In most cases, it will be impossible to include all items that are exemplars of a particular construct. Hence, it will usually be necessary to sample (not arbitrarily select) items representative of the construct (Waters, 1980). In choosing such sampling one should consult members from the population under consideration. Units for analysis, as a working day in the medical environment should be also included in the investigation phase.

The inception phase include as second the analysis of the data, the organization of the resulting information to allow an overall description, to determine the user requirements and design issues.

6.2.2 Designer and the Client –Collaborative

The originator of the new environment is the "client" (Perin, 1973). "Involvement of patients and clinicians in the design of the environment, helps to ensure that specific needs are met, and can increase patients satisfaction and well-being" (Cortvriend, 2005).

The people involved should be involved in what they want to accomplish (Patton, 1990). The people or the client here, is not only the physician who owns the facility, the client is also the patient who visit the practice. Therefore, a selected group of the patients could be involved in the creation and evaluation phase of the design process, patients who have interests or experience in the art and design. That will help the designer to be clear about what users recognize as positive and what as negative, and if he obtains more good evidence to offer the clinical staff and patients, then they will also recognize that the designer that "accentuates the positive" and "eliminates the negative" environmental qualities is essential to their work (Scher, 2001).

The collaboration with the clinical staff will help to identify the possible techniques and trends that could be installed in the facility in the future. The broad discussion will help both designers and users.

The staff in the clinical facility want to offer a good service in an attractive and sympathetic environment and the management's responsibility should be to ensure that there are systems in place which help them. On the other side, designers can find themselves trying to seek approval for a scheme seen as unnecessary by many staff members, and those whose involvement is necessary may not readily make themselves available for consultation. If there is also support by appropriate media to communicate with staff and administrative then the execution of the improvements will be more successful and readily adopted. The techniques used in the case studies such as video recording and photography, will help the designers to execute discussions using the material achieved. Videotapes and photographs are more compelling than written reports in communicating the information to administrators and other key decision makers. Our approach shows how the observational technique can be used to drive a new type of application: helping users make design discussions and decisions. The use of the right media, as video material, will help to avoid that the suggestions of the designer appear too daunting, too lengthy, or too hard to imagine for the people in the healthcare facility. The efficient media will prove that practical solutions are needed, which can indeed be put into practice. The result will be successful, and design issues can become factual to solve the problems which staff themselves feel powerless to do.

6.3 Environmental assessment -Methods and Tools

This section of the chapter focuses on the key issues of measurement and assessment of the environment. It is very important to make clear what is meant by the term "Assessment". Assessment, as it is used here, refers to any methods designed to gain

information about user needs (Waters, 1980). It is widely recognized that any attempt to make the environment work must begin with a statement of user needs. They can be called performance specifications; design goals; in engineering they are often called design criteria; they are simply called requirements or needs (Alexander & Poyner, 1979). Whatever word is used, the main idea is the environmental assessment. Environmental assessment is the data-gathering, diagnostic phase of environmental design (Conyne & Clack, 1981).

6.3.1 Environmental Assessment Approach

Alexander and Poyner (1973) note that most designers would say that the rightness or wrongness of a program is not a factual matter but a moral one; it is not a question of fact, but a question of value. These people argue in the same way about the physical environment itself. They say that the environment cannot be right or wrong in any objective sense but that it can only be judged according to criteria, or goals, or policies, or values, which have themselves been arbitrarily chosen. However, Alexander and Poyner believe that this point of view is mistaken. They believe that it is possible to define design in such a way that the rightness or wrongness of a physical environment is clearly a question of fact.

Users needs are a fact, and they are necessary to define. How can one decide what these needs are? The simplest answer is: "ask the client". However, people are notoriously unable to assess all their own needs, but maybe their desires. Suppose then, that we assess people's needs by watching them. If we are to obtain accurate measurement, we must develop accurate instruments (Waters, 1980).

It is very important that evidence-informed design goals and approaches be included early rather than late in the process of facility programming and design (Ulrich, 2001). Involvement in the initial stages is important and the result will be supportive considerations, which can potentially affect the conceptual phase in the

design process. “What you see in the work determines what you will think to build” (Beyer & Holtzblatt, 1998).

According to Patton (1990), direct, personal contact with and observations of an environment have several advantages for evaluators as follows:

- First, by direct observing program operations and activities the evaluators is better able to understand the context within which the program operates. That in order to build a holistic perspective.
- Secondly, experience with a program allows an evaluators to be open, discovery oriented, and inductive in approach.
- A third strength of observational fieldwork is that evaluators have the opportunity to see things that may routinely escape conscious awareness among participants and staff. Participants in those routines may take them so much for granted that they cease to be aware of important nuances that are apparent only to an observer who has not become fully immersed in those routines.
- A fourth value of the direct observational approach is that the evaluators can learn about things program participants or staff may be unwilling to talk about in an interview. The person being interviewed may be unwilling to provide information on sensitive topics. Through direct experience with and observation of program evaluators can gain information that otherwise would not become available.
- A fifth point is that observation permit the evaluator to move beyond the selective perceptions of others. Interviews are always reporting perception -selective information. Evaluators as field observers will also have selective perceptions. By making their own perceptions part of the data available in a program, evaluators have to develop the interview relating to the comprehensive view constructed in the observation processes.

The designer should see the complexity of the service areas. He can discover things no one else has ever really paid attention to, then he can define the range of requirements, and understand the basic nature of the work processes. A quantitative qualitative mixed approach must be thought and considered, and a combination of methods and tools must be used.

6.3.2 Environmental Assessment Procedure

This section discusses specific tools relevant to the phase for data gathering and also the phase of analysis and representing the results which follow. Those tools and methods which the designers can use to assess a medical environment need to be developed.

Since the designers must conduct a facility visit as a part of the current design process, then the initial stage of any project should include a descriptive exploration for the topic under study (Weller, 2000). A well-structured and thorough investigation of a healthcare facility will help the designer to gather potential data to use in the analysis phase, to define the user needs, pinpoint problems, and operational alternatives.

6.3.2.1 Data Gathering

Measurements

The process of supportive environmental design begins by eliminating environmental factors that are known to be stressful or can have direct impacts on patients and staff (lighting, temperatures, and noise). That in addition to create a layout for the facility and preparing a list of rooms within the square meter available. Those all are physical objective measurements, which could be summarized as follows:

- Layout for the place supported by exactly dimensions.
- Illumination measurements and glare tests on computers and device monitors.
- Room temperatures measurement.

Observations

There are many types of observation processes and those types have been mentioned and discussed previously in Chapter 3. According to the experiences of the case studies performed in Egypt and Germany, two types should be used in the exploratory phase.

- For the examinations and treatment rooms indirect observation must be performed. That by using video camcorders, which should be hidden as possible in order to avoid the disturbance and distraction for both the patient as well as the medical staff member. An acceptance should be attained from the patient, collaboration from the doctor to convince the patients that the material gathered will be used anonymously and only for the development of the healthcare facility.
- In reception and waiting areas it will be difficult to get approval from all the patients involved. Therefore, it is not acceptable to apply the video techniques. Participant direct observation should be conducted using papers and pens to note the critical events and situations.

Interviews

The observation processes should be followed by interviewing the medical staff members. The interview should include three important parts.

The first part is concerned with asking about the feeling of mental and physical stress; the levels of stress, caused by the physical environment (lighting, room temperatures, noise). That with using a perceptual format. As example: use of a Likert scale, which includes discrete points for respondents to use in indicating their judgment. For instance:

No stress	Low	Middle	High	Very High level of stress
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

This part should be extended to include questions such as, whether the medical staff member suffers from pains at the end of the work day. If the answer is

affirmative (Yes), then the staff member could explain which kind pain they suffer from.

The second part is concerning with enquiring into their satisfaction with the physical environment. Aspects of the environment should be defined (for example: the size of rooms, furniture, climate, lighting system and elements, colours, and art works in the environment). Again a perceptual format should be used. For instance:

Very Good	Good	Neutral	Poor	Very Poor
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Asking about each aspect should be followed by open-ended question, where the staff member could express their criticisms and/or suggestions to this aspect of the physical environment.

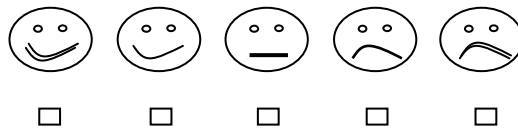
The third part relates to the observation processes and the remarks added by the designer. A semi-structural part in the interview should be developed to attain the staff member's point of view regarding the advantages and disadvantages of the workplace. That is relating to the work procedures that have to be accomplished, the frequently problems which they are faced with in their every day working life. What they would like to change the workplace should be also noted.

The best time to ask user about preferences would be in the midst of the actual activity being scrutinized. However, in a sensitive environment such as medical environment that would effect the activities being performed which have a direct effect on the patient's health. Therefore, the advantage of using the video technique in the observation processes, it would allow for medical staff member(s) to be interviewed while watching their performance on videotape.

Questionnaires

When implementing patient surveys or questionnaires, designers should be sure of the survey instrument, distribution and collection of that instrument. The questionnaire is one of the appropriate tools and could be used to attain the responses and desires of patients regarding the different aspects in the physical environment. In most of the small clinical centers and medical offices the patients are familiar to medical staff members. That could effect the patients to express their responses in an interview. That in addition to the need of a period of time and adequate place to conduct the interview. Therefore, an anonymous questionnaire must be developed in a way that is easy to understand by most patients and in simple a format.

A perceptual format should be used. As example on a similar scale used by the staff, but the discrete points should developed in a simple format instead words. If the patient will indicate his or her satisfaction within the aspects of the environment in five degrees starting from Very Good to Very Poor, then for instance the degree of the satisfaction could be put into a form as follows:



That should be followed with open-ended questions leading to the criticism or suggestions relating each aspect of the environment, relating to, e.g., furniture, climate, lighting, colours, art works, and the environment in general. Below is an example of an open-ended question:

Q. What could be done to change the environment to improve the situation?

The questionnaires should be distributed to a considerable number of patients from different genders, ages, and cultural populations. It is also preferable that one of the

6.3.2.2 Analysis and Presenting the Results

There are common methods for helping the designers to analyze data and other material gathered and to construct interfaces that prompt the information. These are used to determine the combination of attributes and the most perceived value to the users. They provide an awareness of processes, procedures, and activities which have to be accomplished in the medical environments they are designing for.

In the assuming phase in the design process, the quantifying models enable the designer to state in a factual way the limits of staff and patients responses to the surrounding environment. However, this is complemented with an in-depth analysis of the staff and patients requirements and desires. Qualitative complementary models are needed in such a particularity environment as a medical environment.

The results of the measurements of illumination and temperatures, for different parts in the facilities, should be tabulated. The results should be compared with the recommendations and guidelines discussed in Chapter 5. This in order to define where the ambient conditions fall out of the recommended averages and ranges.

Relating to the work processes, the clinical discipline, physical surrounding, socio-cultural conditions, and time have already been mentioned in Chapter 4 as elements of the whole context used to evaluate the environment and its effect on performing the task. Chapter 4 also mentioned the six main tasks to be accomplished by most medical facilities. They are as follows:

- C. Patient/Family: communication with patient and family.
- EX./Treat.: examine and/or treatment of patient and administering medicaments
- Pr./Re.: read and register protocols, patient information, and prescriptions.
- C. Staff: communication among the medical staff
- Assist: assist and cooperate among staff members.
- Arrange: arrange material, tools, place, and/or devices.

Table 33: Context-tasks reciprocative relations and effects.

	Context			
	Clinical-Discipline	Physical-Surroundings	Socio-cultural Conditions	Time
C. Patient/Family	▪ Long consultation with the parent	▪ no eye contact between the doctor and the patient		
EX./Treat	▪ Exam. Table should be accessed from 3 sides	▪ Only one side can be accessed	▪ A women will prefer to undress behind a partition	▪ The exam. Take approximately 80 % of the time all needed
Pr./Re	▪	▪ glare on the monitors	▪ .	▪
C. Staff	▪	▪	▪ Personal space should be considered	▪
Assist	▪	▪ Hinder the assisting activities	▪	▪
Arrange	▪	▪	▪ .	▪

Work analysis is a key factor for a successful definition of user needs and requirements (Kirwan & Ainsworth, 1992). Methods of task and activities analysis have been discussed and presented in Chapter 4. The main subject is the description for performing tasks and the effect of the context. Actually, there are reciprocative effects between the context and the tasks needed to be performed. Requirements expedited by the tasks and effects influenced by the context should be defined and demonstrated. Table 33 illustrates the classification of the context in relation to the tasks that have to be accomplished. The table includes examples of the comments which could be added by the designer while s(he) is reviewing the material provided by the observation processes and interviews with the medical staff. The table could be executed also while interviewing staff members and watching the video material. The structure of the table provides the designer with an overall awareness on the situation.

In relation to the reception and waiting area, direct participant observation would enable the designer to note all the details in the physical environment, that has an effect on the patients, their relations and communication with the medical staff, and among each other in this area. The designer should observe the behaviors of the different population groups of the patients, e.g., elderly patients; disabled patients, patients who come with family and/or children with a buggy, and so forth. Also to note the behavior of the patients at different times, if there is high volume of traffic in the facility, for example how they will behave. The designer should also observe where patients like to have a seat in the waiting area, their reactions to the other patients; how they behave when they come with family. The designer should categorize the notes of all those details and he can support that with some photographs, when it is possible.

The results and other material assimilated by staff interviews and patient's questionnaires should be quantitatively and qualitatively analyzed and presented. The respondents recorded in the Likert scale should be translated into numbers and average response should be calculated. For instance:

No stress	Low	Middle	High	Very High level of stress
0	1	2	3	4

In Chapter 4 tables as Table 10, Table 13, Table 21, include examples for the diagrams that could be developed after calculating the averages. That provides and supports a visual awareness for the designer to define which aspects or elements in the physical environment is being criticized the most.

The comments made by the medical staff and patients should be categorized and the keywords should then be isolated. Examples of which are in Chapter 4, as tables: Table 27, Table 28, Table 29, Table 30, and Table 31. The frequency of the keywords in the comments indicate the most common problems, desires, and/or criticisms aspects relating the elements and the physical environment in general.

The comments made by medical staff should be discussed in-depth using the video material as mentioned before.

Chapter 7

Conclusion

7.1 Contributions: Effective and Affective Medical Environment.

In the last half of the 20th century the medical environments were adapted technologically to serve precise treatment procedures. That has characterized the medical environments to be highly functional and spotlessly clean yet lifeless and sterile. This focus has largely neglected the users of those environments, both the patients and medical staff.

This paradigm began to change in the last fifteen years, and as the term supportive medical environment became widespread within the healthcare services, the market stimulated providers to find ways to attract the patients. At the same time, academic research followed with the newly presented focal goal of the relationship between stress and healing as well as enhancing the influence that the medical environments have on patients, staff, and medical work processes.

The concept of supportive environments refers to environmental characteristics that reduce stress and evoke positive responses from their users on physical, social, and emotional levels. The supportive design goes one major step further by emphasizing the importance of creating environments which facilitate the associated work processes. However, the healthcare managers and designers focus the attention to the design of hospitals which are becoming a small constituent of the whole health care delivery system. Yet, nowadays, ambulatory care has become the major player.

Shifts in healthcare demand and facility use patterns have occurred, as an example of which the increased need for outpatient/ambulatory care service. Ambulatory care is provided in out-patient units in hospitals, in medical centers, and also in medical offices, where patients and their families are involved and take an active role in the medical process.

It is a fact, that there is a need to focus on the design of medical environments where the ambulatory care is provided. In this thesis it was approached that accurate methods have to be developed which should be used by the designers to define and to recognize the issues of those environments and their influence on the work process and users. In general the relationships between people and the designed environment is the major concern of an ergonomics-oriented environmental design research.

The thesis embraced a broad literature review. That provided an understanding of the knowledge base of designing medical environments. The knowledge base is classified into two main sections; healthcare design and human factors.

In addition to that, case studies that were performed in Egypt and Germany applied a quantitative and qualitative mixed methodology approach, using a combination of methods and tools. The case studies involved purposive sampling from various medical disciplines and healthcare facility types, such as medical offices, medical centers, and outpatient departments in hospitals. The fact that the case studies were performed in Egypt and Germany has allowed cross-cultural differences to be identified. It has been assumed that the natural surrounding (being where the problem occurs) is the best place to study the problem, and also the best way to evaluate the methods used in the investigation.

Regarding the case studies in Egypt, three medical centers and out-patient departments in two hospitals were included in the case studies. In Germany, the case studies were carried out in six medical practices from different medical disciplines in addition to three different ambulatory care units in the hospitals of the university of Duisburg-Essen.

For the case studies, a combination of methods were used, as follows:

- Two types of observation processes. First, an indirect observation using video recording techniques was used in the examination and treatment rooms. Secondly, direct observation for the reception and waiting areas using pens and paper to sketch the problems that appeared and using also photography when possible.
- Interviews with medical staff members involved in the medical facilities were included in the case studies.
- Questionnaires were distributed to a considerable number of patients from both genders, various age groups, and from different populations.
- Measurements for the illuminance and temperature levels were taken from different locations in each facility.

The data and material collected have been analyzed and presented in order to explain the particular environmental design aspects and how they affect users and

work processes. The qualitative and quantitative data, given by the case studies, supported crucial understanding to the nature of the problem, answered several questions, and provided useful information about the effects of designed environments on their users. The results demonstrated the following:

- The design state of the environment, in several medical facilities included in the case studies, affected negatively and hindered the activities, the work processes, the collaboration, and social and psychological relations of the users involved. Therefore, the physical environments were not being used as intended and did not provide the positive effects expected by the user.
- The medical staff were suffering from different types of stress and pains caused by the physical environments. In several cases, the medical staff members are not satisfied with their designed work environments, and this added to their feeling of being stressed.
- The patients, in several cases, expressed their dissatisfaction with various aspects in the designed environment. Aspects as colours, lighting, and furniture are the aspects most criticized by the patients, and they have added several comments regarding those aspects.
- Methods and tools used in the investigations are accurate. The methods used in analysis process are simple but efficient and acceptable for designers to understand and to employ them later in their work in tackling problems and analyzing the user requirements.
- Cultural differences, relating to the behaviours and cultural background of the patients and medical staff in Egypt and Germany, were defined and should be considered in the design of medical environments.

The power of an effective and affective medical environment comes from many sources. Paying attention to details in the design will result in better performance in the execution of work processes. It also reduces the stress the medical staff could suffer from, and provides patients with an opportunity to enjoy a more tranquil and caring environment. This in turn yields better results both physical and psychologically. The designer must create a harmony between the requirements of various conditions and standards. At the conceptualization phase in the design process, focus should be directed to a variety of aspects cross-linked by the designer

(i.e., ambient conditions, layout of the spaces, and furnishings). Recommendations and guidelines which touch on the latter have been discussed and presented so as to realize the interdisciplinary approach which must be adapted in designing a complex environment such one intended for medical care.

One of the most significant concerns of this work was to develop methods and tools to define - at the early stages of the design process - the user requirements and the considerations relating the work processes. Furthermore, it was intended to explore what factors lead to positive affect in the medical environment. Methods such as physical measurements, observation, interviewing, and questionnaires are essential in the environmental assessment approach. The spectrum of methods and tools applied in this research were discussed on three levels, the phases of data gathering, analysis, and representing the results.

Designing a medical environment is a significant issue for designers. The work presented and the structure of this thesis will support the efforts of designers to create effective and affective medical environments.

7.2 Future Work

The work presented in this thesis can be extended in several directions. It is hoped that this work will inspire further interest and investigation into medical and also other man-made environments. Further studies are needed. Future research should consider using the multi-method for investigation and analysis to obtain objective and subjective evaluations of use and satisfaction. This is in order to create physical environments that are psychosocially supportive.

Quantitative and qualitative research is needed on all aspects of medical environments. More specific research on particular environments is also important. The pediatric environment, for example, requires its own study, as the results from

studies on adults could not be generalized to the pediatric population. This is because children are more sensitive to the physical environment. The pediatric environments shall be a topic to be explored in future works.

According to Ulrich *et al.* (2004), there are relatively few studies that have examined the effect of environmental factors on medication errors. That is an area of interest for future research for designers, where they can explore the effect of the environmental aspects on medical errors. An additional, related topic would be the role of the healthcare environment in the occurrence of accidents in the medical workplace (both on the behalf of patient and staff).

Colour and light are major factors in man-made environments. They have great impact on human psychological reactions and physiological well-being. There are many types of healthcare environments, and thus more specific research should be done on colour and light and its use in different medical environments. That is to say, on their therapeutic effects and also their suitability and influence on the medical staff and the processes which take place in each environment.

Finally, the research strategy adopted in this thesis could serve as an example for the design community to establish a new attitude towards scientific environmental design research. While the present thesis focused on the medical environments, the underlying research concept of effective and affective environment can be generalized to virtually any designed environment.

Bibliography

Aas, D. 1975. Observing Environmental Behavior: The Behavior Setting . In W. Michelson (Ed.), Behavioral Research Methods in Environmental Design. Community Development Series, Volume 8. Dowden, Hutchinson & Ross, Inc. USA. 280-300.

Alexander, C. & Poyner, B., 1970. The Atoms of Environmental Structure. In G.T. Moor (Ed.). Emerging Methods in Environmental Design Planning. The Massachusetts Institute of Technology. USA.

Alexander, C. & Poyner, B., 1973. The Atoms of Environmental Structure. In Gary T. Moore, Emerging Methods in Environmental Design and Planning. Based on the Proceedings of the Design Methods Group, First International Conference, Cambridge, Massachusetts, June 1968. The Massachusetts Institute of Technology. USA. 307-317.

Allen, O., 1990. Probability, Statistics and Queuing Theory with Computer Science Applications, 2nd. Edition. Academic Press. New York.

Altman, I. & Chemers, M., 1980. Culture and Environment. Brooks/Cole Publishing Company, A Division of Wadsworth, Inc. USA.

Alvarez, L., 2004. The Healing Begins With a Design. The New York Times. September 20, 2004. p. 12.

Amaratunga, D., Baldry, D., Sarshar, M. & Newton, R. 2002. Quantitative and Qualitative Research in the Built Environment: Application of “mixed” Research Approach. In Emerald Journals, Work Study, Volume 51, Number 1, 2002. 17-31.

American Board of Medical Specialties. Homepage:
<http://www.abms.org/member.asp>. Visited 15.11.2005

- Annett, J., 2002.** A Note on the Validity and Reliability of Ergonomics Methods. *Theoretical Issues in Ergonomics Science*, 3(2): 228-232.
- Archer, L. B., 1973.** An Overview on the Structure of the Design Process. In Gary T. Moore, *Emerging Methods in Environmental Design and Planning*. Based on the Proceedings of the Design Methods Group, First International Conference, Cambridge, Massachusetts, June 1968. The Massachusetts Institute of Technology. USA. 285-307.
- Ayoub, M. M., & Miller, M., 1991.** Industrial Workplace Design. In A. Mital, & W. Karwowski (Eds.), *Advances in Human Factors/Ergonomics*, Volume 15: Workspace, Equipment and Tool Design. Elsevier Science Publishers B.V./Academic Publishing Division. Netherlands. 67-92.
- Baier, S. 1988.** Patient perspective. *Journal of Healthcare Design*, 1:13-17. (Proceedings from the First Annual National Symposium on Health Care Interior Design held April 29- May 1, 1988. California,. USA).
- Baum, A. & Valins, S., 1977.** *Architecture and Social Behavior: Psychological Studies of Social Density*. Lawrence Erlbaum Associates, Inc. USA.
- Beck, W. C., 1978.** Hospital Light and Color from the Physician's Standpoint. In B. C. Pierman, *Color in the Health Care Environment: Proceedings of a Special Workshop Held at the National Bureau of Standards*. Gaithersburg, Maryland, November 16, 1976. U.S. Government Printing Office. Washington. 5-7.
- Beech, H. R., Burns, L. E., & Sheffield, B. F. 1982.** *A Behavioral Approach to the Management of Stress: A Practical Guide to Techniques*. John Wiley & Sons Ltd. USA.
- Bender, B. & Blessing, L. TM, 2003.** Re-Interpretation of Conceptualization- A Contribution to the Advance of Design Theory. In U. Lindemann, *Human Behavior in Design: Individuals, Teams, Tools*. Springer-Verlag. Germany.
- Beyer H., & Holtzblatt K. 1998.** *Contextual Design, Defining Customer-Centred Systems*. Academic Press, A Harcourt Science and Technology Company. USA.
- Birren, F., 1979.** *Color Psychology and Color Therapy: A Factual Study of the Influence of Color on Human Life*. The Citadel Press: A division of Lyle Stuart, Inc. USA.
- Boyce, P. R., 2005.** Evaluating Office Lighting. In N. Stanton, A. Hedge, K. Brookhuis, E. Salas, & H. Hendrick (Eds.), *Handbook of Human Factors and Ergonomics Methods*. CRC Press LLC. USA. pp. 69-1 – 69-6.
- Bridger, R. S., 1995.** *Introduction to Ergonomics*. McGRAW-HILL, INC. Singapore.

Bright, K., Cook, G., O'Neil, L. A., & Hill, S. L., 2003. Inclusive Lighting design in the home. Proceedings from Include 2003: inclusive design for society and business, an international conference at the Royal College of Art. London.

Bruder, R. & Rohmert, W., 1991. Analyse und Gestaltung der Beziehungen zwischen Patient, Zahnarzt und HelferIn innerhalb des Arbeitssystems "Zahnarztpraxis". In K. Landau (Hrsg.), Arbeitsbedingungen in Krankenhaus und Heim. Bayerischen Staatsministerium für Arbeit, Familie und Sozialordnung. München.

Calkins, M.P. 1988. Design for Dementia: Planning Environments for the Elderly and the Confused. National Health Publishing, A Division of Williams & Wilkins. USA.

Cama, R., 1997. Programming. In S. O. Marberry (Ed.), Healthcare Design. John Wiley & Sons, Inc. USA. 26-36.

Canter, S. & Canter, D., 1979. Building for Therapy. In S. Canter & D. Canter, Designing for Therapeutic Environments: A Review of Research. John Wiley & Sons, Ltd. Great Britain. 1-28.

Carpman, J. R. & Grant, M., 1997. Wayfinding. In S. O. Marberry (Ed.), Healthcare Design. John Wiley & Sons, Inc. USA. 275-294.

Cassell, C. & Symon, G. (Eds), 1994. Qualitative Methods in Organizational Research. SAGE Publications. London, Great Britain.

Cassell, C. & Symon, G. 1994. Qualitative Research in Work Context. In C. Cassell, & G. Symon (Eds.), Qualitative Methods in Organizational Research: A Practical Guide. SAGE Publications Ltd. London. 1-13.

Castelluccio, S., 1978. The Relationship of Color Planning in Designing a Pediatric Oncology Unit to the Symbolic Meaning of Colors as Seen in Patient's Graphic Productions. In B. C. Pierman, Color in the Health Care Environment: Proceedings of a Special Workshop Held at the National Bureau of Standards. Gaithersburg, Maryland, November 16, 1976. U.S. Government Printing Office. Washington. 25-26.

Citra, M., 2001. Art in Health care buildings: Is any art good art?. In A. Dilani, (Ed.), Design & Health: The Therapeutic Benefits of Design, The Result of the 2nd International Conference on Design and Health organized by the Karolinska Institute in Stockholm. AB Svensk Byggtjänst. Stockholm. 303-310.

Clauß, G. & Ebner, H., 1983. Grundlagen der Statistik für Psychologen, Pädagogen und Soziologen, 7. Auflage. Volk und Wissen Volkseigener Verlag. German Democratic Republic.

- Conyne, R. K., & Clack, R. J., 1981.** Environmental Assessment and Design: A new Tool for the Applied Behavioral Scientist. Praeger Publishers. New York, USA.
- Cook, G., Dalke, H., & Camgöz, N., 2003.** Colour and Lighting design for inter-modal transport environments. Proceedings from Include 2003: inclusive design for society and business, an international conference at the Royal College of Art. London.
- Cortvriend, P., 2005.** The effect of the Healthcare Environment on Patients and Staff. homepage: www.mbs.ac.uk. Visited 11.03.2005.
- Cross, N., Christiaans, H. & Dorst, K. 1996 .** Analysing design activity. Chichester; New York : Wiley.
- Currie, R.M. & Faraday, J.E., 1977.** Work Study, Fourth Edition. Pitman Publishing for the British Institute of Management. Great Britain.
- Cushman, W. H., Nielsen, W. J. & Pugsley, R. E., 1983.** Workplace Design. In E. M. Eggketon (Ed.), Ergonomic Design For People At Work, Volume 1: Workplace, Equipment, and Environmental Design and Information Transfer. Human Factors Section, Eastman Kodak Company. New York, USA.
- Dalke, H., Camgoz, N., Bright, K., Cook ,G., Littlefair, P., & Loe, D. 2003.** Research with users: colour design and lighting for public transport, prison and health care environments. An international conference on inclusive design for society and business 25 - 28 March 2003, Royal College of Art, London – UK.
- Danielsson, C., 2005.** Office Environment, Health & Job Satisfaction, An Explorative Study of Office Design's influence. Licentiate thesis. Stockholm.
- Davis, G. & Ayers, V., 1975.** Photography Recording of Environmental Behavior. In W. Michelson (Ed.), Behavioral Research Methods in Environmental Design. Community Development Series, Volume 8. Dowden, Hutchinson & Ross, Inc. USA. 235-279.
- Decortis, F., Noirfalise, S., Saudelli, B. & Ispra, J. without year.** Cognitive ergonomics methodology to apprehend cooperative activities and interactions. Homepage: <http://www.sv.cict.fr/cotcos/pjs/MethodologicalApproaches/CogErgandEngmethodology/CogergpaperDecortis.htm>. Visited 20.05.2005
- Devlin, A. S. & Arneill, A. B., 2003.** Health Care Environments and Patient Outcomes: A Review of the Literature. Environment and Behavior, Vol. 35 No. 5, 665-694.
- Dilani, A., 1999.** Design and Care in Hospital Planning. Karolinska Institute: Institute for Psychosocial Factors and Health, Public Health and Treatment Research, Design & Health. Stockholm.

- Dilani, A., 2001.** Psychosocially Supportive Design –Scandinavian Healthcare Design. In Dilani, A., (Ed.), *Design & Health: The Therapeutic Benefits of Design*, The Result of the 2nd International Conference on Design and Health organized by the Karolinska Institute in Stockholm. AB Svensk Byggtjänst. Stockholm. 31-37.
- Donnerbauer, R., 2004.** Gutes Licht als Wohlfühlfactor. *Der Facility Manager: Gebäude und Anlagen besser planen, bauen, bewirtschaften.* November 2004. 11. Jahrgang, Heft 11: 40-42.
- Duffy, T., 1997.** Furniture. In S. O. Marberry (Ed.), *Healthcare Design*. John Wiley & Sons, Inc. USA. 122-138.
- Eastman, C. M., 1973.** On the Analysis of Intuitive Design Processes. In Gary T. Moore, *Emerging Methods in Environmental Design and Planning*. Based on the Proceedings of the Design Methods Group, First International Conference, Cambridge, Massachusetts, June 1968. The Massachusetts Institute of Technology. USA. 21-37.
- Eiseman, L., 2000.** *Pantone® Guide to Communicating with Color*. Grafton Press, Ltd. Florida, USA.
- El Guindi, F. 2000.** From Pictorializing to Visual Anthropology. In H. R. Bernard (Ed.), *Handbook of Methods in Cultural Anthropology*. AltaMira Press. USA.
- Enander, A. E., & Hygge, S. 1990.** Thermal stress and human performance. *Scand J. Work Environ Health* 16(1):44-50.
- Farbstein, J. & Kantrowitz, M., 1978.** *People in Places: Experiencing, using, and changing the built environment*. Prentice-Hall, Inc.. New Jersey, USA.
- Flach, J. M. & Kuperman, G. G., 2001.** Victory by Design: War, Information, and Cognitive Systems Engineering. In M. McNeese, , E. Salas & M. Endsley (Eds), *New Trends in Cooperative Activities: Understanding System Dynamics in complex Environments*. Human Factors and Ergonomics Society. Santa Monica, USA. 259-283.
- Flynn, J. E., 1978.** Studies of the Subjective Influence of light and Color. In B. C. Pierman, *Color in the Health Care Environment: Proceedings of a Special Workshop Held at the National Bureau of Standards*. Gaithersburg, Maryland, November 16, 1976. U.S. Government Printing Office. Washington. 13-18.
- Fontaine, C. W., 1980.** *Psychoendocrine and Performance Reactions to Psychological Stress Induced by a Simulated work Environment*. North Carolina State University at Raleigh PH.D.. Printed in 1985 by University Microfilms International. Ann Arbor, Michigan, U.S.A.

- Ford, J. D., 1980.** Training and Environmental Design. In L. Krasner (Ed.), *Environmental Design and Human Behavior: A Psychology of the Individual in Society*. Pergamon Press Inc. New York.
- Forsthofer, R., 1995.** Stress am Bildschirmarbeitsplatz: Ansätze zu einer Systemorientierten Analyse des Stresserlebens bei der Arbeit mit dem Computer. Verlag Dr. KOVACH. Germany.
- Frasca-Beaulieu, K. 1999.** Interior Design for Ambulatory Care Facilities: How to Reduce Stress and Anxiety in Patients and Family. *Journal of ambulatory care management*. 22(1): 67-73.
- Friesdorf, W., & Gobel, M. 2003.** Safety and reliability of clinical work processes. In H. Strasser, K. Kluth, H. Rausch, and H. Bubb (Eds.) *Quality of work and products in enterprises of the future*. Ergonomie Verlag. Stuttgart. 669-672.
- Gamberale, F., Kjellberg, A., & Akerstedt, T. 1990.** Behavioral and psychophysiological effects of the physical work environment. *Scand J Work Environ Health* 16(1):5-16.
- Gedenryd, H., 1998.** How Designers Work. Jabe Offset AB, Lund. Sweden.
- Geider, F. J., 1995.** Basiskarte: Datenaufbereitung und erste Ergebnisse. In K. Rogge (Ed.), *Methodenatlas für Sozialwissenschaftler*. Springer-Verlag. Wemding, Germany.
- Goossens, R.H.M., Veelen, M. A. van & Snijders, C.J., 2002.** Medesign Delft: Products for Healthcare at the Faculty Industrial Design Engineering 1977-2002. Delft University of Technology. Netherlands.
- Gottschalk, B., 1981.** Arbeitsstrukturierung und Informationsbedarf zur Informationsabhängigkeit von Innovationen im Bereich Arbeitsorganisation. Dissertation. Fachbereich I Rechts- und Wirtschaftswissenschaften der Technischen Hochschule Darmstadt. Darmstadt, Germany.
- Graham, M., 1978.** Hospital Facilities: Color Them Caring. In B. C. Pierman, *Color in the Health Care Environment: Proceedings of a Special Workshop Held at the National Bureau of Standards*. Gaithersburg, Maryland, November 16, 1976. U.S. Government Printing Office. Washington. 9-12.
- Grandjean, E., 1980.** Fitting the Task to the Man, An Ergonomic Approach. Taylor & Francis Ltd. Great Britain.
- Hall, J., Jackson, D.P., & Metcalf, L.E., 1992.** Design Technology: Programming User Needs. *Journal of Healthcare Design*, 4:109-118. (Proceedings from the Fourth International Symposium on Healthcare Design held November 14-17, 1991. Boston, Mass. USA).

- Harris, S. R.** 2004. Systemic-Structural Activity Analysis of HCI Video Data. In O. W. Bertelsen, M. Korpela, & A. Mursu, (Eds.), *Proceedings of ATIT04: first International Workshop on Activity Theory Based Practical Methods for IT-Design*, September 2-3, 2004, Copenhagen, Denmark. 48-63.
- Hartley, J. F.**, 1994. Case Studies in Organizational Research. In C. Cassell, & G. Symon (Eds.). *Qualitative Methods in Organizational Research*. SAGE Publications. London, Great Britain. 208-229.
- Havenith, G.**, 2005. Thermal Conditions Measurement. In N. Stanton, A. Hedge, K. Brookhuis, E. Salas, & H. Hendrick (Eds.), *Handbook of Human Factors and Ergonomics Methods*. CRC Press LLC. USA. pp. 60-1 – 60-16.
- Hedge, A.**, 2005. Environmental Methods. In N. Stanton, A. Hedge, K. Brookhuis, E. Salas, & H. Hendrick (Eds.), *Handbook of Human Factors and Ergonomics Methods*. CRC Press LLC. USA. pp. 59-1 – 59-4.
- Hedge, A.**, 2005. Heat Stress Indices. In N. Stanton, A. Hedge, K. Brookhuis, E. Salas, & H. Hendrick (Eds.), *Handbook of Human Factors and Ergonomics Methods*. CRC Press LLC. USA. pp. 62-1 – 62-8.
- Heimstra, N. W. & McFarling, L. H.**, 1974. *Environmental Psychology*. Brooks/Cole Publishing Company, A Division of Wadsworth, Inc. USA.
- Held, J.** 2003. A management tool of user's experiences. In H. Strasser, K. Kluth, H. Rausch, and H. Bubb (Eds.) *Quality of work and products in enterprises of the future*. Ergonomia Verlag. Stuttgart. 697-700.
- Held, J.** 2003. A syntax for the recording of work processes. In H. Strasser, K. Kluth, H. Rausch, and H. Bubb (Eds.) *quality of work and products in enterprises of the future*. Ergonomia Verlag. Stuttgart. 681-84.
- Held, J.** 2003. Analysis of an intensive care unit. In H. Strasser, K. Kluth, H. Rausch, and H. Bubb (Eds.) *quality of work and products in enterprises of the future*. Ergonomie Verlag. Stuttgart, 2003 . 673-76.
- Hellberg, J. & Lindberg, G.**, 1975. Strategic Decisions in Research Design. In W. Michelson (Ed.), *Behavioral Research Methods in Environmental Design*. Community Development Series, Volume 8. Dowden, Hutchinson & Ross, Inc. USA.
- Hignett, S.** 2005. Using Ergonomics to Improve Clinical Safety. *Proceedings from MEK 2005, 4. Medizintechnik- und Ergonomiekongress (Medical Devices: Human Factors and Patient Safety*. Münster, Germany.
- Horton, J. G.**, 1997. Lighting. In S. O. Marberry (Ed.), *Healthcare Design*. John Wiley & Sons, Inc. USA. 166-179.

- Hosking, S. & Haggard, L., 1999.** Healing the Hospital Environment: Design, Management and Maintenance of Healthcare Premises. E & FN Spon. China.
- Huijbregts, R., Papadimitriou, E., & Magnolfi, J. 2002.** Collaborative research and design of an innovative workplace. Harvard design school.
- Intille, S. S., Tapia, E. M., Rondoni, J., Beaudin, J., Kukla, C., Agarwal, S., Bao, L., & Larson, K. 2003.** Tools for Studying Behavior and Technology in Natural Settings. in Proceedings of UBICOMP 2003: Ubiquitous Computing, vol. LNCS 2864, A.K. Dey, A. Schmidt, & J.F. McCarthy (Eds.). Berlin Heidelberg: Springer, 2003.157-174.
- Jick, T. D., 1983.** Mixing Qualitative and Quantitative Methods: Triangulation in Action. In J. V. Maanen (Ed.), Qualitative Methodology. SAGE Publications, Inc. USA. 135-148.
- Johnson, W. M. & Rouse, M. O. 1963.** The Human Side of Medicine. In R. B. Robins, The Environment of Medical Practice. Year Book Medical Publishers, Inc.. USA.
- Johnson, W. M. & Rouse, M. O. 1963.** The human side of medicine. In R. B. Robins & M. D. (Eds.) The environment of medical practice. Year book medical publishers, Inc. USA.
- Jones, W.J., 1994.** Ambulatory Care Design: A Patient-focused Approach. Journal of Healthcare Design, 4:109-118. (Proceedings from the sixth International Symposium on Healthcare Design held November 18-21, 1993, Chicago, USA).
- Kaenampornpan, M. & O'Neill, E., 2004.** An Integrated Context Model: Bringing Activity to Context. In workshop on Advanced Context Modelling, Reasoning and Management. Nottingham, UK.
- Karg, W. & Staehle, H., 1982.** Analyse der Arbeitssituation: Verfahren and Instrumente. Rudolf Haufe Verlag GmbH & Co. KG, Freiburg, Germany.
- Kellman, N., M. D., Arch, M. 1988.** History of healthcare environments. Journal of Healthcare Design, 1:19-27. (Proceedings from the First Annual National Symposium on Health Care Interior Design held April 29- May 1, 1988. California,. USA).
- King, N., 1994.** The Qualitative Research Interview. In C. Cassell, & G. Symon (Eds.). Qualitative Methods in Organizational Research. SAGE Publications. London, Great Britain. 14-36.
- Kirwan, B. & Ainsworth, L. K. (Eds.), 1992.** A Guide to Task Analysis. Taylor & Francis Ltd. Great Britain.

- Kjellberg, A.** 1990. Subjective, behavioral and psycho-physiological effects of noise. *Scand J Work Environ Health* 16(1):29-38.
- Krasner, L.** 1980. Environmental Design in Perspective: Theoretical Model, General Principles, and Historical Context. In L. Krasner (Ed.), *Environmental Design and Human Behavior: A Psychology of the Individual in Society*. Pergamon Press Inc.. USA. 1-35.
- Kroemer, K., Kroemer, H., & Kroemer-Elbert, K.** 2001. *Ergonomics: How to Design for Ease and Efficiency*. Second Edition. Prentice-Hall, Inc. USA.
- Kroemer, K.H.E.** 1991. Sitting at Work: Recording and Assessing Body Postures, Designing Furniture for the Computer Workstation. In A. Mital & W. Karwowski (Eds.), *Advances in Human Factors/Ergonomics, Volume 15: Workspace, Equipment and Tool Design*. Elsevier Science Publishers B.V./Academic Publishing Division. Netherlands. 93-112.
- Laakso, S. A. & Laakso, K.** without year. DUO: A Discount Observation Method. Internet source: <http://www.cs.helsinki.fi/u/salaakso/papers/DUO.pdf>. Visited 5.01.2005.
- Lawton, P.** 1979. Therapeutic Environments for Aged. In S. Canter & D. Canter, *Designing for Therapeutic Environments: A Review of Research*. John Wiley & Sons, Ltd. Great Britain. 233-276.
- Leibrock, C. A.** 2000. *Design Details for Health: Making the Most of Interior Design's Healing Potential*. John Wiley & Sons, INC. USA.
- Leighton, P.** 1997. *The Work Environment: The Law of Health, Safety and Welfare*. Second edition. Nicholas Brealey. Great Britain.
- Linton, P. E.** 1992. Creating a total healing environment. *Journal of Healthcare Design*, 5:167-174. (Proceedings from the Fifth Symposium on Healthcare Design, held November 19-22, 1992, San Diego, California., USA).
- Mahnke, F. H. & Mahnke, R. H.** 1987. *Color and Light in Man-made Environment*. Van Nostrand Reinhold Company Inc.. USA.
- Mahnke, F. H.** 1996. *Color, Environment, and Human Response: An Interdisciplinary Understanding of Color and its Use as a Beneficial Element in the Design of The Architectural Environment*. Van Nostrand, Reinhold: A division of International Thomson Publishing Inc. USA.
- Malkin, J.** 1995. The Design of Healing Environments. Appendix in S. O. Marberry & L. Zagon, *The Power of Color: Creating Healthy Interior Spaces*. John Wiley & Sons, Inc.. USA.

- Malkin, J., 2002.** Medical And Dental Space Planning: A Comprehensive guide to Design, Equipment, And Clinical Procedures. John Wiley & sons, New York. USA.
- Manser, T., Rall, M., & Wehner, T. 2003.** Process-Oriented systems analysis results of a case study in anaesthesia. In H. Strasser, K. Kluth, H. Rausch, and H. Bubb (Eds.) quality of work and products in enterprises of the future. Ergonomia Verlag. Stuttgart. 677-680.
- Marberry, S. O. & Zagon, L., 1995.** The Power of Color: Creating Healthy Interior Spaces. John Wiley & Sons, Inc.. USA.
- Marrone, R.L. & Rasor, R.A., 1972.** Behavior Observation and Analysis. Rinehart Press, A division of Holt, Rinehart and Winston, Inc. USA.
- Mathis, J. F., 1997.** Ceilings. In S. O. Marberry (Ed.), Healthcare Design. John Wiley & Sons, Inc. USA. 107-119.
- Maver, T. W., 1973.** Appraisal in the Building Design Process. In Gary T. Moore, Emerging Methods in Environmental Design and Planning. Based on the Proceedings of the Design Methods Group, First International Conference, Cambridge, Massachusetts, June 1968. The Massachusetts Institute of Technology. USA. 195-202.
- McNeese, M., Salas, E. & Endsley, M. (Eds), 2001.** New Trends in Cooperative Activities: Understanding System Dynamics in complex Environments. Human Factors an Ergonomics Society. Santa Monica, USA.
- Mead, P. G., 2004.** Light, emotion and design. In D. McDonagh, P. Hekkert, J. van Erp, & D. Gyi (Eds.), Design and Emotion: The Experience of Everyday Things. Taylor & Francis. Great Britain. 48-52.
- Mears, M. 2005.** Message from the Director: The Public Defender: Dealing with Stress. Homepage: <http://www.gidc.com/aboutus-council-directors-column.htm>. Visited 7.04.2005.
- Meister, D., 1991.** Advances in Human Factors/Ergonomics, Volume 17: Psychology of System Design. Elsevier Science Publishers B.V./Academic Publishing Division. Netherlands.
- Miller, R. L. & Swensson, E. S., 1995.** New Directions in Hospital and Healthcare Facility Design. McGraw-Hill, Inc.. Hong Kong.
- Miller, R. L. & Swensson, E. S., 2002.** Hospital and Healthcare Facility Design, Second Edition. W. W. Norton & Company, Inc.. Singapore.
- Monz, A. & Monz, J., 2001.** Design Als Therapie: Raumgestaltung in Krankenhäusern, Kliniken, Sanatorien. Verlagsanstalt Alexander Koch GmbH. Leinfelden- Echterdingen. Germany.

- Mummendey, H. D., 1987.** Die Fragebogen-Methode: Grundlagen und Anwendung In Persönlichkeits-, Einstellungs- und Selbstkonzeptforschung. Verlag Für Psychologie. Dr. C. J. Hogrefe. Germany.
- Murrell, K. F. H., 1965 reprinted 1975.** Ergonomics: Man in His Working Environment. Chapman and Hall Ltd. Great Britain.
- Nader, R. 1989.** Keynote Address. Journal of Healthcare Design. 1:3-5. (Proceedings from the First Annual National Symposium on Health Care Interior Design held April 29- May 1, 1988. Carlsbad, California, USA).
- Nemeth, C. P., 2004.** Human factors Methods for Design: Making Systems Human-Centered. CRS Press LLC. USA.
- Nicholson, A. S., 1991.** Anthropometry In Workplace Design. In A. Mital, & W. Karwowski (Eds.), Advances in Human Factors/Ergonomics, Volume 15: Workspace, Equipment and Tool Design. Elsevier Science Publishers B.V.. Amsterdam.
- Nicholson, A. S., 1991.** Anthropometry in Workspace Design. In A. Mital & W. Karwowski (Eds.), Advances in Human Factors/Ergonomics, Volume 15: Workspace, Equipment and Tool Design. Elsevier Science Publishers B.V./Academic Publishing Division. Netherlands. 3-28
- Niebel, B., & Freivalds, A. 2003.** Methods, Standards, and Work Design, Eleventh Edition. McGraw-Hill, a business unit of the McGraw-Hill Companies, Inc. USA.
- On-line health and safety manual.** Homepage:
<http://healthandsafety.shu.ac.uk/UniversitySafetyManual/6.24pol.htm>. Visited 19.01.2205.
- Osten-Sacken, V. E., 2005.** Gesundheit. Design Report: Gesundheit. 2/05:16-17.
- Paradise, R. C. & Cooney, N. L., 1980.** Methods for Assessments of Environments. In L. Krasner (Ed.), Environmental Design and Human Behavior: A Psychology of the Individual in Society. Pergamon Press Inc.. New York, USA. 106-131.
- Patton, M. Q. 1990.** Qualitative Evaluation and Research Methods, Second Edition. Sage Publications, Inc. USA.
- Perin, C., 1973.** With Man in Mind: An Interdisciplinary Prospectus for Environmental Design. Heffernan Press Inc. USA.
- Piopelle, K. & Held, J. 2003.** Team work & task performance analysis of anesthesia induction procedures. In H. Strasser, K. Kluth, H. Rausch, and H. Bubb (Eds.) quality of work and products in enterprises of the future. Ergonomia Verlag. Stuttgart. 689-692.

- Plowman, T. 2003.** Ethnography and Critical Design Practice. In B. Laurel (Ed.), *Design Research: Methods and Perspectives*. The MIT Press. Cambridge, Massachusetts. 30-38.
- Pressler, G. 1992.** Ambulatory Care Design: the New Generation. *Journal of Healthcare Design*, 5:63-72. (Proceedings from the Fifth Symposium on Healthcare Design, held November 19-22, 1992, San Diego, California., USA).
- Purpura, S., 2003.** Overview of Quantitative Methods in Design Research. In B. Laurel (Ed.), *Design Research: Methods and Perspectives*. The MIT Press. Cambridge, Massachusetts. 63-69.
- Radke, R., 1997.** Carpet. In S. O. Marberry(Ed.), *Healthcare Design*. John Wiley & Sons, Inc. USA. 139-165.
- Rea, M. S. & Boyce, P. R., 2005.** The Context and Foundation of Lighting Practice. In N. Stanton, A. Hedge, K. Brookhuis, E. Salas, & Hendrick, H. (Eds.), *Handbook of Human Factors and Ergonomics Methods*. CRC Press LLC. USA. pp. 67-1 – 67-8.
- Reich, Y. 1991.** Design knowledge acquisition: task analysis and a partial implementation. *Engineering Design Research Center*; (91)12-38.
- Ritz, F. & Friesdorf, W. 2003.** Team performance in high risk environment-communication in the operating room. In H. Strasser, K. Kluth, H. Rausch, and H. Bubbs (Eds.) *quality of work and products in enterprises of the future*. Ergonomia Verlag. Stuttgart, 2003 . 693-696.
- Ulrich, R. S., 1990.** Effects of healthcare interior design on wellness: theory and recent scientific research. *Journal of Healthcare Design*, 3:97-109 (Proceedings from the Third Symposium on Health Care Interior Design held November 15-18, 1990. Calif, USA).
- Rogers, Y. & Ellis, J., 1994.** Distributed Cognition: an Alternative Framework for Analyzing and Explaining Collaborative Working. *Journal of Information Technology*, 1994, vol. 9(2), 119-128.
- Rosenstein, B. 2002.** Video Use in Social Science Research and Program Evaluation. *International Journal of Qualitative Methods* 1(3) Summer, 2002.
- Rutter, B. G., 1993.** Environmental Design Technologies: Designing the Ergonomically correct medical Environment. *Journal of Healthcare Design*. 8:127-131. (Proceedings of the Eighth Symposium on Healthcare Design, held November 16-19, 1995. San Diego, California, USA).
- Sato, K., 2004.** Collective views for forming the foundation of design research. *Visible language* 38.2. 218-37.

- Scher, P., 2001.** The Exeter Evaluation: A Basis for Hospital Design and Art in The Millennium. In A. Dilani (Ed.), *Design & Health -The Therapeutic Benefits of Design, The Result of the 2nd International Conference on Design and Health* organized by the Karolinska Institute in Stockholm. AB Svensk Byggtjänst. Stockholm. 317-327
- Schoenwetter, C., 2005.** Weiß ist nicht gleich Weiß. Design Report: Gesundheit. 2/05:30-35.
- Schricker, R., 1999.** Raumzauber: Entwerfen oder wie die Dinge entstehen; Gestaltung von Räumen und Produkten. Deutsche Verlags-Anstalt GmbH. Leipzig, Germany.
- Schubert, M., 1973.** Interviewing in Social Work Practice: an Introduction, 5th Printing. Council on Social Work Education. USA.
- Schulze, S., 2003.** Views on the Combination of Quantitative and Qualitative Research Approaches. *Progression*, 25(2):8-20. South Africa.
- Senior, P., 2001.** Art and Health. In A. Dilani (Ed.), *Design & Health -The Therapeutic Benefits of Design, The Result of the 2nd International Conference on Design and Health* organized by the Karolinska Institute in Stockholm. AB Svensk Byggtjänst. Stockholm. 81-84.
- Shepley, M. M., 1997.** Design Evaluation. In S. O. Marberry (Ed.), *Healthcare Design*. John Wiley & Sons, Inc. USA. 73-104.
- Shepley, M. M., 2001.** Research on Healthcare Environments for Children and their Families. In A. Dilani (Ed.), *Design & Health -The Therapeutic Benefits of Design, The Result of the 2nd International Conference on Design and Health* organized by the Karolinska Institute in Stockholm. AB Svensk Byggtjänst. Stockholm. 25-29.
- Sieger, C. & Sieger, M., 2004.** A Pleasurable Practice. *Sieger Insight, The Sieger Design Magazine Full Service*. 1/04:34-39.
- Silverman, D., 1993.** Interpreting Qualitative Data: Method for analysing Talk, Text and Interaction. SAGE Publications Ltd. London.
- Sime, J.D. & Sime, D.A., 1979.** A Therapeutic Environment for Forensic Patients. In S. Canter & D. Canter, *Designing for Therapeutic Environments: A Review of Research*. John Wiley & Sons, Ltd. Great Britain. 175-212.
- Sisson, T. R. C., 1978.** Some Relationships of Color and light to Patient Care. In B. C. Pierman, *Color in the Health Care Environment: Proceedings of a Special Workshop Held at the National Bureau of Standards*. Gaithersburg, Maryland, November 16, 1976. U.S. Government Printing Office. Washington. 19-24.

- Smith, L.L. & Deivanayagam, S., 1991.** Designing for Workspace Safety. In A. Mital & W. Karwowski (Eds.), *Advances in Human Factors/Ergonomics, Volume 15: Workspace, Equipment and Tool Design*. Elsevier Science Publishers B.V./Academic Publishing Division. Netherlands. 113-148.
- Stanton, N. A., Baber, C. & Young, M. S., 2005.** Observation. In N. Stanton, A. Hedge, K. Brookhuis, E. Salas, & H. Hendrick (Eds.), *Handbook of Human Factors and Ergonomics Methods*. CRC Press LLC. USA. pp. 28-1 – 28-7.
- Steidl, R. E., & Nelson, L. M. 1972.** The ergonomics of environmental design and activity management for the aging. Council of planning librarians. USA.
- Stouffer, J., 2001.** Integrating Human Centered Design Principles in Progressive Health Facilities. In A. Dilani (Ed.), *Design & Health -The Therapeutic Benefits of Design, The Result of the 2nd International Conference on Design and Health* organized by the Karolinska Institute in Stockholm. AB Svensk Byggtjänst. Stockholm. 285-291.
- Styne, A. F., 1978.** Lighting and Color in Health Care Facilities-from a Designer's Viewpoint. In B. C. Pierman, *Color in the Health Care Environment: Proceedings of a Special Workshop Held at the National Bureau of Standards*. Gaithersburg, Maryland, November 16, 1976. U.S. Government Printing Office. Washington. 27-28.
- Thomas, J. R., & Nelson, J. K Thomas, J. R., & Nelson, J. K. (Eds.) 1990.** *Research Methods in Physical Activity*, Second Edition. Human Kinetics Publishers, Inc. USA.
- Tools & Techniques, Direct Observation, without year.** Homepage:
<http://www.idemployee.id.tue.nl/g.w.m.rauterberg/lecturenotes/UFTdirectobservati on.pdf>. Visited 25.01.2005.
- Tools & Techniques, Task analysis, without year.** Homepage:
<http://www.idemployee.id.tue.nl/g.w.m.rauterberg/lecturenotes/UFTtask-analysis.pdf>. Visited 8.01.2005.
- Torrice, A. F., Asid, & Ifda. 1988.** Color for healing. *Journal of Healthcare Design*, 1:35-43. (Proceedings from the First Annual National Symposium on Health Care Interior Design held April 29- May 1, 1988. California,. USA).
- Ulrich, R. S. & Hygge, S. (Eds.), 1985.** *Research on Environment and People: Methods, Quality Assessment, New Directions*. Proceedings of a multidisciplinary conference, Gävle, Sweden, June 6-7, 1985.
- Ulrich, R. S., 1985.** Aesthetic and Emotional Influences of Vegetation: A Review of the Scientific Literature. Document/ Swedish Council for Building Research; 1985, 22. Stockholm, Sweden.

- Ulrich, R. S., 2001.** Effects of Healthcare Environmental Design on Medical Outcomes. In A. Dilani (Ed.), *Design & Health: The Therapeutic Benefits of Design, The Result of the 2nd International Conference on Design and Health* organized by the Karolinska Institute in Stockholm. AB Svensk Byggtjänst. Stockholm. 49-59.
- Ulrich, R., Quan, X., Zimring, C., Joseph, A., & Choudhary, R., 2004.** The Role of the Physical Environment in the Hospital of the 21st Century: A Once-in-a-Lifetime Opportunity. Report to The Center for Health Design for the Designing the 21st Century Hospital Project.
- Van Harrison, R., 1985.** The Person-Environment Fit Model and the Study of Job Stress. In T. A. Beehr & R. S. Bhagat (Eds.), *Human Stress and Cognition in Organizations*. John Wiley & Sons, Inc. USA. 23-56.
- Vihma, S., 1995.** Products as Representation –a Semiotic and Aesthetic Study of Design Products. University of Art and Design Helsinki UIAH. Finland.
- Villecco, M. & Brill, M. 19981.** *Environmental/Design Research: Concepts, Methods and Values*. NY: Publishing Centre for Cultural Resources. New York.
- Ward, A., 1973.** Notes on a Therapeutic Environment. In Gary T. Moore, *Emerging Methods in Environmental Design and Planning*. Based on the Proceedings of the Design Methods Group, First International Conference, Cambridge, Massachusetts, June 1968. The Massachusetts Institute of Technology. USA. 247-260.
- Waters, J. M., 1980.** An Interactionist Approach to Environmental Design. In L. Krasner (Ed.), *Environmental Design and Human Behavior: A Psychology of the Individual in Society*. Pergamon Press Inc.. New York, USA.
- Webster, P. D., & Johnson, B. H., 1999.** *Collaborative Design Planning*. Institute for Family-Centered Care. Maryland. USA.
- Weller, S. C., 2000.** Structured Interviewing and Questionnaire Construction. In H. R. Bernard (Ed.), *Handbook of Methods in Cultural Anthropology*. AltaMira Press. USA.
- Wells-Thorpe, J., 2001.** Design for enhanced recovery. In A. Dilani (Ed.), *Design & Health: The Therapeutic Benefits of Design, The Result of the 2nd International Conference on Design and Health* organized by the Karolinska Institute in Stockholm. AB Svensk Byggtjänst. Stockholm. 311-315.
- Wetterberg, L. 1990.** Lighting nonvisual effects. *Scand J Work Environ Health* 16(1):26-8.
- Wettig, C., 2005.** Auf Messers Schneide. Design Report: Gesundheit. 2/05:18-23.

- Wickings, I., 1994.** Improving Hospital Design: A Report on the King's Fund Hospital Design Competition 1993. King Edward's Fund for London. England.
- Wilson, R. N., 2003.** Teamwork in the Operating Room. In D. Harper & H. M. Lawson, *The Cultural Study of Work*. Rowman & Littlefield Publishers, Inc.. USA. 7-20.
- Xiao, Y. & the Lotas Group, 2001.** Understanding Coordination in a Dynamic Medical Environment: Methods and Results. In M. McNeese, E. Salas & M. Endsley (Eds), *New Trends in Cooperative Activities: Understanding System Dynamics in complex Environments*. Human Factors and Ergonomics Society. Santa Monica, USA. 242-258.
- Young, M. S. & Stanton, N. A., 2005.** Applying Interviews to Usability Assessment. In N. Stanton, A. Hedge, K. Brookhuis, E. Salas & H. Hendrick (Eds.), *Handbook of Human Factors and Ergonomics Methods*. CRC Press LLC. USA. pp. 29-1 29-6.
- Zimring, C., Nepp, B., & Hillman, R., 1997.** Site Visits. In S. O. Marberry (Ed.), *Healthcare Design*. John Wiley & Sons, Inc. USA. 3-25.