إقـــــرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

Effect of Lighting on patients' Well-being

تأثير الإضاءة على الصحة العامة للمرضى

أقر بأن ما اشتملت عليه هذه الرسالة إنما هو نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد، وإن هذه الرسالة ككل أو أي جزء منها لم يقدم من قبل لنيل درجة أو لقب علمي أو بحثي لدى أي مؤسسة تعليمية أو بحثية أخرى.

DECLARATION

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification

Student's name:	اسم الطالب/ة: صفاء عواد حبيب
Signature:	التوقيع: صفاء
Date:	التاريخ: 30 أغسطس 2015

Islamic University of Gaza

Deanery of Graduate Studies

Faculty of Engineering

Master of Architecture Program

Effect of Lighting on patients' Well-being

تأثير الإضاءة على الصحة العامة للمرضى

By

Safaa Awad Deeb Habib

Supervisor

Dr. Ahmed Salama Muhaisen

"A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master in Architectural Engineering, Faculty of Engineering, The Islamic University of Gaza, Gaza– Palestine"

2015 - 1436

بسم الله الرحمن الرحيم

الجامعة الإسلامية – غزة
The Islamic University - Gaza

مكتب نائب الرئيس للبحث العلمي والدراسات العليا هاتف داخلي 1150

الرقم Ref ج س غ/35/.....

التاريخ Date 2015/07/23.....

نتيجة الحكم على أطروحة ماجستير

بناءً على موافقة شئون البحث العلمي والدراسات العليا بالجامعة الإسلامية بغزة على تشكيل لجنة الحكم على أطروحة الباحثة/ **صفاء عواد دياب حبيب** لنيل درجة الماجستير في **كلية الهندسة** **قسم الهندسة المعمارية** وموضوعها:

تأثير الإضاءة على الصحة العامة للمرضى

Effect of lighting on patients'well-being

وبعد المناقشة العلنية التي تمت اليوم الأربعاء 05 شوال 1436هـ، الموافق 2015/07/22م الساعة الحادية عشرة صباحاً بمبنى اللحيدان، اجتمعت لجنة الحكم على الأطروحة والمكونة من:

د. أحمد سلامة محيسن	مشرفاً و رئيساً	.....
د. سناء يوسف صالح	مناقشاً داخلياً	.....
د. نهاد محمود المغني	مناقشاً خارجياً	.....

وبعد المداولة أوصت اللجنة بمنح الباحثة درجة الماجستير في كلية الهندسة/ قسم الهندسة المعمارية.

واللجنة إذ تمنحها هذه الدرجة فإنها توصيها بتقوى الله ولزوم طاعته وأن تسخر علمها في خدمة دينها ووطنها.

والله ولي التوفيق،،،

مساعد نائب الرئيس للبحث العلمي و للدراسات العليا

أ.د. فؤاد علي العاجز

Abstract

Light is a fundamental part of life. Light gives us the natural rhythm of day and night, determines how we see things, and brings our world to life. Accordingly, it has a major impact on our sense of well-being, our emotions and our functioning. The notion that a well-balanced and attractive environment is of major importance to patients' health is not new. This research comes in an attempt to study the lighting design for hospitals and its impact on patients' well-being (visual, biological and psychological) which can promote patient recovery. The research also seeks to study the impact of illuminance level, correlated color temperature (CT), color render index (CRI) and lighting control on lighting design. In addition, the research display the lighting design in Al Shifa hospital patients' room in surgery, internal medicine and heart care departments.

In this context, the research assumes that the natural and artificial lighting have a significant impact on patients' well-being and the illuminance level, color temperature (CT), color render index (CRI) and lighting control are the most important characteristics of light to be considered. The research is carried out using Post-Occupancy Evaluation (POE) tool, which used mixed method that depend on quantitative and qualitative data. Questionnaire was used to collect qualitative data and analyze it, and the number of participants who fill the questionnaire were 30 inpatient, amd those participants are distributed on 21 patients' room, during the application of the questionnaire measurements of lighting intensity inside patients room were taken by using iPad app called Luxmeter. The results indicate that type of existed lighting (Fluorescent) in surgery, internal medicine and heart care departments in Al-shifa' hospital was suitable, whereas Ra= 74, and color of lighting is daylight which fits with patients room, but there is a problem in lighting design, which is represented in the absence of variety in colors of lighting and controlling method in colors of lighting. In addition, it indicate that good design includes the availability of dimmed lights during sleeping time, which increases public satisfaction level about lighting and increases the biological effects on patients' well-being inside the rooms during sleeping, healthy sleeping can help to improve the patients' well-being by helping to secrete the human body melatonin hormone in darkness.

Good design according to design consideration, which includes design quality that is specialized in lighting intensity, color temperature, color render index (CRI) and control system lead to improve the well-being of patients, which increases the level of public satisfaction, visual comfort, improves the feeling of the place, mood, and psychological comfort. Therefore, the research recommends using high quality lighting types with high Ra, coloring temperature (CT) of lighting similar to daylight such as neutral white. In addition, use lighting that include automatic control in healthcare facilities. In addition, use several illumination for the patients' that serve every patient individually, and must provide bedside lighting fixtures, high intensity lighting above patients' beds, and patient control of these lighting. Moreover, providing dimmed lights for patients' at sleeping time.

الملخص

يعتبر الضوء جزء أساسي في حياتنا اليومية، حيث يعطي الضوء الاحساس بتعاقب الليل والنهار، وهو الذي يحدد رؤيتنا للأشياء من حولنا. ووفقا لذلك فإن الضوء له تأثير رئيسي على الاحساس بالصحة العامة، والتأثير على المشاعر والوظائف الحيوية، يأتي هذا البحث في محاولة لدراسة تصميم الضوء لمراكز الرعاية الصحية وتأثيره على صحة المرضى بصرياً وبيولوجياً ونفسياً، والتي بدورها تعزز من عملية شفاء المريض. يهدف البحث الى دراسة مستوى تأثير الاضاءة، ودرجة الحرارة المرتبطة بلون الاضاءة، وخاصية الاظهار اللوني وآلية التحكم بالإضاءة على تصميم الاضاءة. ويعرض هذا البحث تصميم الاضاءة على اقسام مستشفى الشفاء بمدينة غزة (الجراحة والباطنة وعناية القلب).

في هذا السياق، يفترض البحث أن الاضاءة الطبيعية والصناعية لها تأثير هام على الصحة العامة للمرضي، كما يفترض أن كل من مستوى الإنارة ودرجة الحرارة المرتبطة باللون، وخاصية الإظهار اللوني أهم الخصائص للضوء والتي يجب أخذها بعين الاعتبار. تم تنفيذ الاستبانة باستخدام أداة Post-Occupancy evaluation، والتي تستخدم المنهج المندمج بين التحليلي والوصفيmixed method والتي تعتمد على البيانات الكمية والكيفية وتحليلها، وقد شارك في تعبئة الاستبانة 30 نزيل موزعون على 21 غرفة مبيت، ومن خلال تطبيق الاستبانة وأخذ قياسات شدة الاضاءة داخل غرف في كل من قسم الجراحة وقسم الباطنة وقسم عناية القلب بواسطة استخدام تطبيق على الجهاز اللوحي (IPad) ويسمى التطبيق باسم (Lux-meter). أشارت النتائج إلي أن نوعية الاضاءة المستخدمة في أقسام الجراحة والباطنة وعناية القلب داخل غرف المرضى هي اضاءة الفلورسنت وأنها مناسبة حيث أن معامل الاظهار اللونيRa=74، ولون هذه الاضاءة هي اضاءة نهارية والتي تلائم غرف المرضى، ولكن هناك مشكلة في تصميم الاضاءة داخل الغرف والتي تتمثل في غياب التنوع في ألوان الاضاءة، وغياب التحكم في ألوان الاضاءة، بالإضافة إلى ذلك تشير النتائج إلى أن التصميم الجيد للإضاءة والذي يتضمن وجود الإضاءة الخافتة خلال فترة النوم يزيد من مستوى الرضا العام عن الاضاءة ويحسن التأثيرات البيولوجية على الصحة العامة للمرضى داخل الغرف الخاصة بهم خلال فترة النوم، حيث أن النوم الصحي يساعد على تحسين الصحة العامة للمرضى من خلال إفراز الجسم لهرمون الميلاتونين في الظلام أثناء فترة النوم.

التصميم الجيد طبقاً لمعايير التصميم، والذي يتضمن التصميم عالي الجودة المتخصص في شدة الاضاءة، ودرجة الحرارة المرتبطة بلون الاضاءة، وخاصية الاظهار اللوني للضوء ونظام التحكم في تلك الاضاءة، كل ذلك يؤدي الى تحسين الصحة العامة للمرضى، وبالتالي زيادة مستوى الرضا العام عن الاضاءة وزيادة الراحة البصرية والتي تعمل على تحسين شعور الاحساس بالمكان، والمزاج، والراحة النفسية. كما وتوصي النتائج باستخدام أنواع من الاضاءات تكون ذات جودة عالية، وذات معامل Ra عالي أعلى من 80، كما يجب أن تكون درجة الحرارة المرتبطة بلون الاضاءة مشابهة لضوء النهار باستخدام لون الأبيض المحايد Neutral White. كما توصي بتوفير اضاءات متعددة للمرضى، والتي تخدم كل مريض على حدة، كما يجب تزويد كل سرير مريض بوحدة إنارة جانبية، ويجب وضع اضاءة ذات شدة عالية توضع أعلى سرير المريض.

To whom I owe for their endless support,
encouragement, and compassion,
My family, husband's family and friends,
I do dedicate this humble thesis.

Acknowledgement

Foremost, I wish to extend my sincere thanks to those who participated in producing this work. First, I am grateful to ALLAH (SWT) for the support received to accomplish this thesis. Moreover, I would like to gratefully and sincerely thank my supervisor, Dr. Ahmed Muhaisen, whose encouragement, guidance and support from the initial to the final level enabled me to accomplish this research.

Very special thank goes to the manger of El Shifa Hospital for assisting in obtaining the necessary data and for permitting the author surveying the departments. A very special thank is owed to the patients and medicine staff who assisted in applying questionnaire.

Table of Contents

List of tables

List of figures

List of Abbreviations

Abbreviations	Meaning
C.C.T	Correlated colour temperature
E.B.D	Evidence based design
P.O.E	Post-occupancy evaluation
C.W.L	Cool white light
D.L	Day light
O.H.E	Optimal healing environment
A.C.T.H	Adrenocorticotropic hormone
W.H.O	World health organization
C.A.B.E	Commission for architecture and the built Environment
C.M.Fs	Color matching functions
C.R.I	Color rendering index
L.E.D	Light Emitting Diode
V.L.T	Visible light transmission
H.A.D.S	Hospital Anxiety and Depression Scale
M.O.H	Ministry of health

Chapter 1

Introduction

1.1 Introduction

This chapter discusses the importance of this study through presenting the research problem, followed by reporting about the methodology adopted to answer the researches' questions.

Lighting quality is one of the determinants of indoor environment quality. Lighting is critical to human functioning as it allows to see things and perform activities. But it is also important because it affects human beings psychologically and physiologically. Several studies have documented the importance of light in reducing depression, decreasing fatigue, improving alertness, modulating circadian rhythms, and treating conditions such as hyperbilirubinemia among infants (Ulrich, Zimring, Joseph, Quan, &Choudhary, 2004). Further, the presence of windows in the workplace and access to daylight have been linked with increased satisfaction with the work environment (Boyce , Hunter, & Howlett, 2003). Studies also show that adequate light levels are linked to reduced medication-dispensing errors in pharmacies. Thus, incorporating light into healthcare settings can be beneficial for patients as well as the staff who work there. With regards to human perception, correlated color temperature (CCT) and illuminance level are the two most important characteristics of light to be considered (Barkmann, Wessolowski, & Schulte-Markwort, 2011).

According to Palestinian Health Information Centre the average length of stay in Palestinian hospitals is 2.5 days (2.6 days in the Gaza Strip, while 2.3 days in the West Bank). In 2010 it was recorded the longest average staying in the European Gaza Hospital EGH (4.5 days), while the lowest average in Tal al-Sultan (1.3 days) (Ministry of Palestinian Health, 2010).

So the research aims to highlight the effects of natural and artificial lighting on patients' well-being which affects the average length of stay. Lighting in Gaza hospitals have many problems which other hospitals around the world are suffering from and does not compatible with patients and staff needs. The research assumes that the natural and artificial lighting have a significant impact on patients' well-being in Gaza hospitals. It assumes that the proper lighting design affect in patient satisfaction on healing environment. Also it assumes that the illuminance level, color temperature (CT), color render index (CRI) and lighting control are the most important characteristics of light to be considered.

The research used mixed approach to carry out the study by using POE tool, which used mixed method that depend on quantitative and qualitative data. Questionnaire was used to collect qualitative data and analyze it, during the application of the questionnaire measurements of lighting intensity inside patients' room were taken by using iPad app called luxmeter. The Questionnaire was used to collect qualitative data by gathering the feedback from patients' experiences about lighting in their rooms. And used quantitative measures including lighting intensity, as a validation tool and key metric in building evaluation and compared with the occupant feedback to provide a better understanding of values.

1.2 Research Problem

In the design of healthcare facilities, medical professionals and architects are increasingly realizing the importance of creating a 'healing environment' that addresses the totality of patient and staff needs. In an effort to create this environment in modern hospitals, considerable attention is paid to detail, color, form, light and shade. Light can increase visual performance and affects how a person feels, and has a role to play in improving healthcare by creating a relaxed or uplifting ambience. It is noted that lighting design in the Gaza hospitals does not take sufficient concern for lighting design in hospitals and compatible with patients' needs(Visual, biological and Psychological. Whereas the design of lighting (illuminance level, color temperature (CT), color render index (CRI) and lighting control) have the same patterns and doesn't optimize with patients' age, kind disease, psychiatric and emotional. Begeman, van den Beld, & Tenner (1997) suggest that biological lighting needs of humans are different from visual lighting needs, and lack of adequate light for biological stimulation can lead to health problems. There is also strong evidence that shows that exposure to light helps in reducing depression, alleviating pain, and improving sleep and circadian rhythms among patients and, thus, supports the healing process. As expected lighting in Gaza hospitals have the same problems which other hospitals around the world are suffering from (Ministry of Palestinian Health, 2010).

1.3 Research Hypothesis

The research assumes that the natural and artificial lighting have a significant impact on patients' well-being. It assumes that the proper lighting design affects the patients' satisfaction in healing environment, Also it assumes that the illuminance level, color temperature (CT),color render index (CRI) and lighting control are the most important characteristics of light to be considered.

1.4 Importance of the Research

Studying the Effect of Lighting on patients' Well-being in Gaza Hospitals is very important because:

- There are lack of studies that investigate the effects of lighting on patients' well-being in Gaza Hospitals.
- Provide a reference to architect, engineers or lighting designers considered in order to achieve better indoor environment quality and provide the basic knowledge and be the frame work for ideas of future lighting designs in hospitals.

1.5 Objectives of the Research

The main objectives of this research is to investigate the impact of lighting (natural and artificial) on patients well-being in Gaza hospitals. All of the following are secondary objectives of the research.

- Studying the relationship between Evidence-based design (EBD) and healing environment,
- Highlighting the connection between built environment and healing,
- Studying the natural connection between day light and artificial lighting in hospitals and beneficial for the recovery of the patient,
- Determining the consideration that affect design of lighting in hospitals which affect the patient well-being,
- Finding of the effect of lighting on patient well-being, which include visual, biological and psychological effects.
- Finding the effect of lighting intensity, color temperature and control system on patients' satisfaction.

1.6 Methodology

This study applied mixed approach and it used evidence-based approach to evaluate physical environment in the healing environment, which include evaluate lighting design in patients' room. Evidence-based has been applied by a post-occupancy evaluation (POE) tool. A POE assesses strengths and weaknesses of design decisions in relation to human behavior in a built environment. And a POE usually includes a mix of quantitative and qualitative techniques. So the research used survey methodology and quantitative measures to assess lighting in patients' room and its impact on patient well-being.

Questionnaire was used to collect qualitative data by gathering the feedback from patients' about their experience about lighting in their rooms. And used quantitative measures include lighting intensity, as validation tool and key metric in building evaluation and compared with the occupant feedback to provide a better understanding of results.

A Questionnaire was used to determine the satisfaction of respondent during each light environment and investigate the effect of natural and artificial lighting on patients' well-being in surgery, internal medicine and heart care department in Al-Shifa Hospital. The questionnaire targeted inpatients (male and female). In addition, lighting intensity was measured by iPad application (LuxMeter), which uses the camera of iPhone or iPad to measure the light intensity. The data was analyzed by computer software (SPSS Statistics).Measurements were used as a validation tool.

The methodology started with literature review about the previous attempts for healing environment and lighting in healthcare that added scope and breath to the study. Then, data was collected through the following mixing of Quantitative and Qualitative methods.

- Take measurements of lighting intensity.
- Distribution the questionnaires on patients' then collection of the questionnaires.
- Analyzing the questionnaires and measurements.

1.6.1 Flow Chart of Methodology

The research methodology chart serves as a guidance in achieving the objectives and scopes of the study. It schematically designs in detail the process of study, in terms of how the data is collected and how it is processed and analyzed to achieve the objectives of the study.

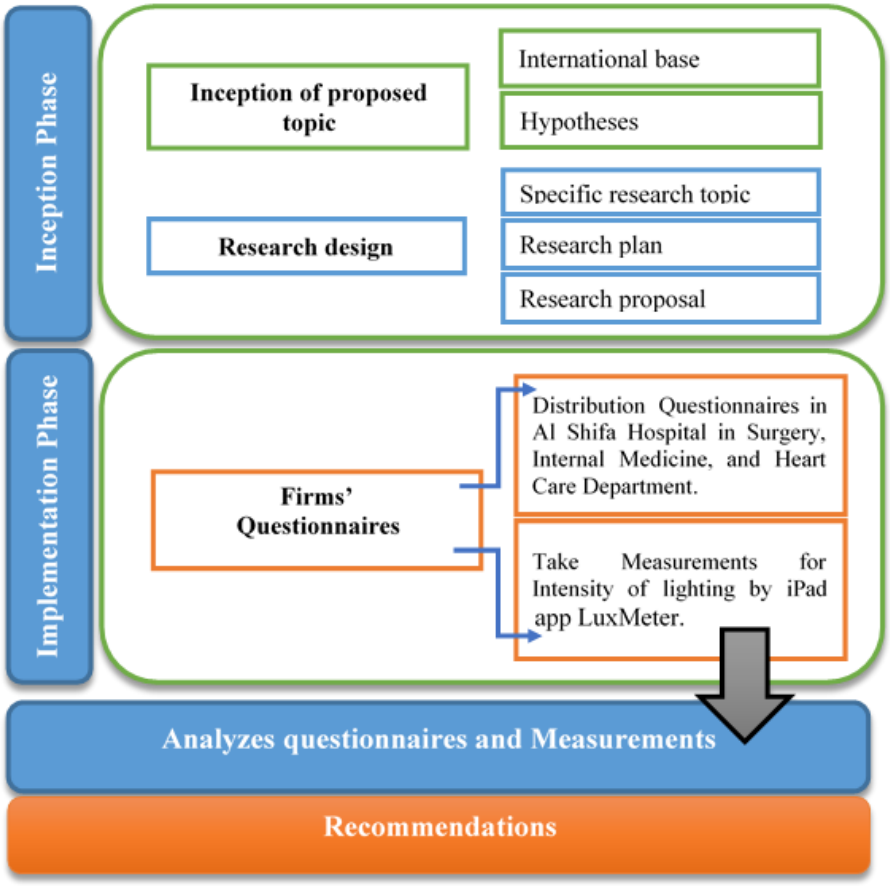


Figure 1.1: Flow Chart of Methodology

1.7 Research Limits

The research deals with the hospitals in the Gaza Strip, Especially with Al-shifa hospital patients' room –surgery, internal medicine and heart care- to determine the study and target inpatient in these department. The research limits are:

- The effects of natural and artificial lighting on patients' well-being in Gaza hospital wards.
- The effects on patient well-being (Visual, biological and Psychological).
- The factors of lighting (intensity, color temperature (CT), color render index (CRI) and lighting control).

1.8 Sources of Information

The Research depends on several sources of information varied between the theoretical sources for the scientific information and the field study, these sources can be listed as follows:

- Conference and journal papers.
- Books that deal with similar subjects.
- Internet.
- Field measurements tools to collect photometric data.
- Surveys (Questionnaire) inpatients.

1.9 Structure of the Research

The research is presented in six chapters. The first chapter which is a general introduction is composed of the research problem, hypothesis, importance, objectives, and sources of information, methodology and an overview of previous studies that dealt with the similar subjects.

Chapter 2 introduces a literature review about the definition of Evidence-based design and Healing Environment and strategies for Promoting a healing environment.

Chapter 3 presents a literature review about the Lighting in hospitals and its effects on patients' well-being in their room. In addition, the main factors affect lighting quality are discussed in this chapter. The new lighting solution are involved in this chapter.

Chapter 4 Explains the Methodology of these research and show a questionnaire target group, sample selection and measurement tool (LuxMeter). In addition explain the design and characteristics of lighting in surgery, internal medicine and heart care department in Al-shifa hospital.

Chapter 5 discusses the effects of lighting on patients' Well-being in Gaza Hospitals by analyzing the SPSS and measurements results.

Chapter 6 concludes the research by summarizing its findings.

1.10 Previous Studies

1. Kamali, & Abbas, (2012). Healing Environment: Enhancing Nurses' Performance through Proper Lighting Design.

Based on a pilot study, this study investigated how the quality services provided by the nurses could be achieved through proper lighting design in a recently built healthcare center in Putrajaya, Malaysia. Data collection involved personal site observations, photographic documentations, interviews and questionnaire surveys. Overall, 120 nurses participated as questionnaire respondents. The SPSS analysis revealed that nurses' age affects their opinion about current lighting design of the hospital. Implication of this study is upon the proper lighting design which could enhance nursing care and minimize human errors, thus contributing towards a better quality of life within the healing environment. The study suggested that the lighting design of tasks which are done by difficulty needs improvement.

2. Unwin, (2011). Night Lighting in Hospitals – and its Impact on Staff and Patients.

To investigate the impact of the night time usage of lighting in hospitals on staff and patients, photometric measurements and objective observations were balanced with the subjective experiences of those who work in the context. The main contexts examined were three wards at a hospital in London. Four wards were also visited at a hospital in northern England, to verify the findings, 27 staff completed alertness surveys and 37 patients filled in sleep quality surveys, the morning after the same three all-night shifts. Both staff and patients offered anecdotal information whilst the surveys were being filled in. A wealth of anecdotal information from interviews revealed that the needs of staff and patients were not met by the night lighting at the most fundamental level. It was found that the practice of night lighting differs from the assumptions made in the lighting guidelines.

The study suggest that the needs of the people who carry out the unpopular nightshifts have been neglected for quite some time and the only way to understand what they need is by listening to them. As value is subjective, why don't we turn to psychology by asking people what they really value and then try to create more of it?" For example, providing a dark place to rest and accepting that having a short nap makes the night shift easier may increase the alertness and sense of well-being of staff on the night shift.

3. Kronqvist, (2010). The Influence of the Lighting Environment on Performance and Well-Being in Offices.

This study presents an experimental study with 47 participants on the influence of lighting on performance and well-being in an office environment. Well-being, alertness and performance were evaluated and measured in two rooms with artificial lighting and one room with day lighting. The evaluations were correlated to cortisol/melatonin saliva samples, illuminance and spectral composition of the lighting. The results show day lighting to have a sustained influence on alertness and performance and it is furthermore concluded that the level of cortisol in saliva was not influenced by the illuminance and

did not have an influence on performance. The participants preferred a lighting with different kinds of light sources to a more neutral lightning and gave it higher ratings for well-being. The analysis shows that comfort did not influence alertness.

4. Aripin, (2007). 'Healing Architecture': Daylight in Hospital Design

The study reviews the role of daylighting design as one of the physical aspects in hospital design to create a healing environment. The effects of physical aspects on patients' outcomes are highlighted. Pilot studies on Malaysian public hospital buildings are carried out to investigate the design and implementation of lighting (artificial and natural light) and its relationship to other environmental factors. Key findings on the physical aspects affecting daylighting design in 4-bed ward environments are explicitly noted. The paper calls for a comprehensive consideration on the physical aspects (i.e. daylighting design) in a healing environment as a strategy for implementation on a sustainable hospital design. The effort to have 'one-off' design for public hospital in Malaysia through improved procurement system is a commendable starting point. However, stringent requirements on the physical aspects to meet environmental issues should be explicitly stated in the design briefs of hospital developments. These requirements must be conform by healthcare designers and validated by the healthcare providers. The present scenario suggests that healthcare designers ought to consider issues beyond the project brief and requirement. It should be noted that conflicting issues in hospital environment: 'physical to physical' (e.g. daylight versus solar heat gain) and 'physical to psychological' (daylight vs. undesirable glare) can only be resolved with good understanding of daylighting design. In conclusion, the study embarked upon the physical aspects (i.e. daylighting) of healing environment in hospital design could significantly reinforce the project briefs provided by the healthcare provider (Ministry of Health Malaysia).

5. Shamsul, Sia, Ng, &Karmeganm, (2013). Effects of Light's Color Temperatures on Visual Comfort Level, Task Performances, and Alertness among Students

This study presents how Correlated color temperatures (CCT) of the light source in indoor environment plays an imperative role in addressing both psychological and physiological functions of the occupant. As one of the determinants of lighting quality, CCT are of particular importance which affects quality of work and in classroom learning. The aim of this study is to determine the effects of warm white light (WWL) (CCT = 3,000K), cool white light (CWL) (CCT = 4,000K) and artificial daylight (DL) (CCT=6,500K) on the performances, subjective alertness level, visual comfort level and preferences of student in Faculty of Medicine and Health Sciences, University Putra Malaysia. Methodology: A laboratory controlled experiment was conducted on total of 47 undergraduate students volunteered to participate in a series of test under three colored light sources. FrACT software was used to assess visual task performance, modified office lighting survey (OLS) questionnaire was used to evaluate subjective comfort level and preferences, typing test and karolinska sleeping scale (KSS) alertness level monitoring was conducted. Result: Significant increase was observed in subjective alertness level ($p=0.041$) and computer-based performances ($p=0.001$) under DL

condition in relative to WWL condition. In terms of typing performances, respondents performed significantly better in term of typing speed under CWL than DL and WWL. Conclusion: The study concludes that the CWL and DL were more beneficial for alertness level and academically activities for both computer-based and paper-based activities.

1.11 Conclusion

This chapter presented the problem of lighting design in the Gaza hospitals, which doesn't take sufficient concern for lighting design in hospitals and its compatibility with patients' needs(Visual, biological and Psychological. Whereas the design of lighting (illuminance level, color temperature (CT), color render index (CRI) and lighting control) have the same patterns and does not optimize with patients' age, kind disease, psychiatric and emotional. It assumed that the natural and artificial lighting have a significant impact on patients' well-being. and proper lighting design affects the patients' satisfaction in healing environment, Also it assumes that the illuminance level, color temperature (CT),color render index (CRI) and lighting control are the most important characteristics of light to be considered. So, The research used mixed approach to carry out the study by using POE tool, which used mixed method that depend on quantitative and qualitative data.

The chapter clarified some previous studies which dealt with similar aspects. It is concluded that there is a lake of studies which dealt with the effect of lighting on patients' wellbeing and especially in the Gaza Strip.

Chapter 2

Evidence-Based Design And Healing Environment

2.1 Introduction

This chapter reviews the evidence-based design (EBD), which is used in the planning, design and construction of healthcare with focus on patient comfort and caregiver performance to improve health outcomes. Moreover, describe the method and tools to apply EBD. Then it focuses with details on the healing environment, which share with EBD in play an important role in making hospitals less risky and stressful, promoting more healing for patients, and providing better places for staff to work.

In addition, this chapter will discuss goals and strategies for promoting a healing environment with focuses on physical environment strategy, which investigate noise, light, color, landscape, air quality and liberalizing family visitation for healing environment. Then it reviews the healing environment in healthcare and same-handed rooms.

2.2 Evidence-Based Design

There is a process used by professionals of healthcare facilities in the planning, design, and construction of healthcare design called evidence based design EBD, an evidence based designer working with informed client, and makes decision based on what researcher information he has, from project evaluation, and from evidence collected from the questions of the client. Improvements in the organization utilization of resources should be demonstrated by EBD (McMullough, 2010).

The intentional try to base building decisions on the best available evidence that researcher reaches with the goal of enhancing outcomes and of keeping on monitoring the success or failure for ensuing decision-making. Focuses on patient stress and fatigue, staff stress and operational efficiency & productivity for facility. (Malkin, 2008)

2.2.1 Evidence-Based Design Techniques:

There are two EBD techniques to promote wellbeing in patients' room (Malkin, 2008).

- Patient Comfort, which is determined as following: see figure (2.1)

1- Single patient rooms with access to natural light and views.

2- Use of daylight for visual and biological functions

3- Dedicated spaces for family in patient care rooms

4- Meditation rooms and positive diversions such artwork, gardens, fountains, green spaces

5- Noise-reduction and acoustic improvements

Figure 2.1: patient comfort technique. Source: Cooper Lighting, 2014

- Caregiver Performance

1. Acuity-adaptable rooms

2. Nursing stations are decentralized

3. Increased physician lounges

4. Same-handed versus “mirror” patient room design

5. Ceiling lifts in patient rooms to prevent caregiver injury & fatigue

2.2.2 Method

As seen in figure (2.2): EBD divided into four procedure (Malkin, 2008).

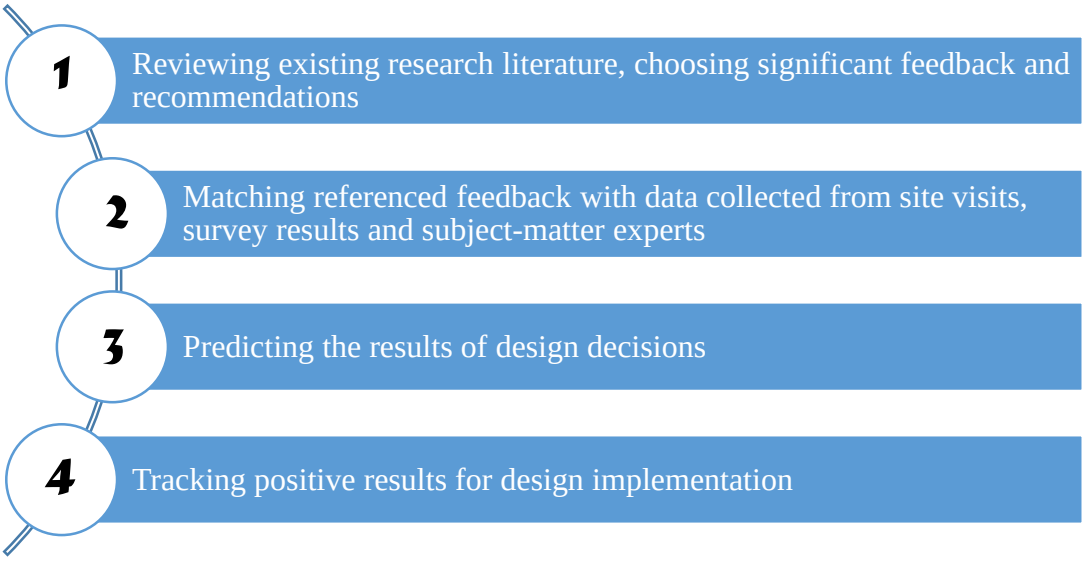


Figure 2.2: Procedure of method for EBD. Source: (Malkin, 2008).

Other sources supply a specific guide to practical applications of achieving EBD objectives; some are listed below:

a. Meta-analysis template

Ray Pawson(2006) in his book suggests a meta-analysis template, which may be applied to EBD.

A systematic review process should follow five steps (Pawson, 2006):

1. Review question by Formulating
2. Identifying and gathering evidence
3. Estimating the quality of the evidence
4. Data must be Extracting, processing and systematizing
5. Disseminating results.

b. Conceptual model

Environmental research is more likely to result in performance guidelines than in prescriptive regulation. Varieties of information sources are helpful: literature from psychology, sociology, anthropology, economics, management, engineering and industrial design. The Internet, the press, conferences and exemplary facilities are also good resources. To demonstrate evidence-based practices, the model below illustrates four means of dealing with research and related methods. See figure (2.3) (Hamilton , 2006):

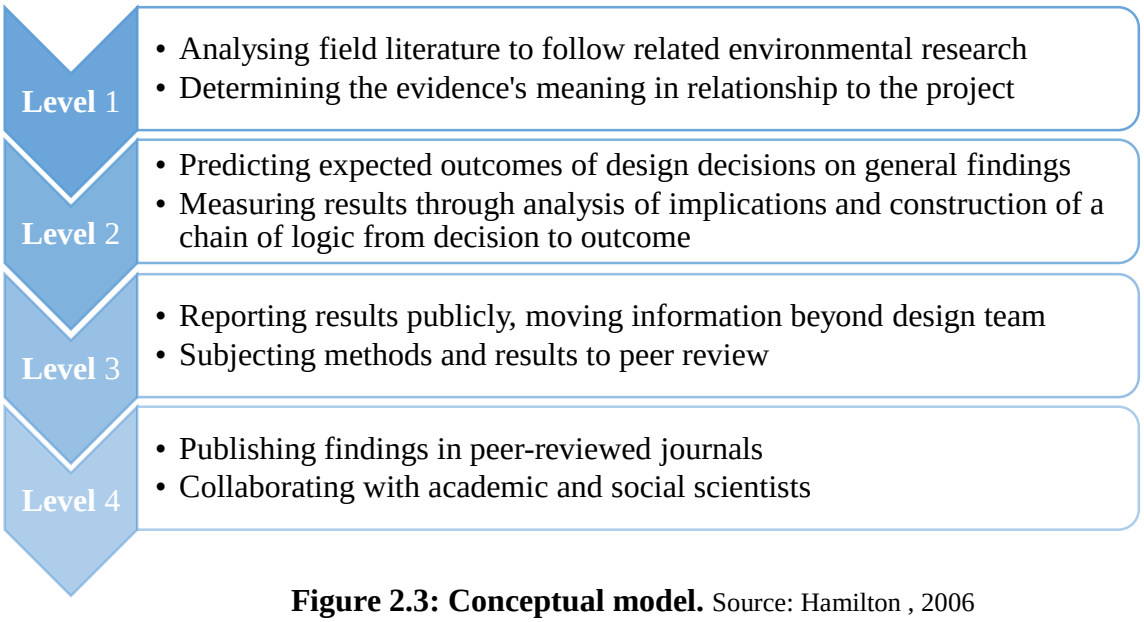


Figure 2.3: Conceptual model. Source: Hamilton , 2006

c. Strategies

Ten strategies to help EBD decision-making (Ulrich R., et al., spring 2008):

- Begin with problems. Identify the problems the project is trying to solve and for which the facility design plays an necessary role
- Use an integrated multidisciplinary approach with appropriate senior involvement, ensuring that everyone with problem-solving tools is included.
- Maintain a patient- and family-centered approach; patient and family experiences are key to defining goals and assessing results.
- Focus on financial operations past the first-cost impact, exploring the cost-effectiveness of design options over time and considering multi-year investment returns.
- Apply disciplined participation and criteria management. These processes use decision-making tools such as SWOT analysis, analytic hierarchy processes and decision trees, which may also be used in design.

- Establish incentive-linked criteria to maximize design-team motivation and involve end occupants with checklists, surveys and emulations.
- Use strategic partnerships to make new products with hospital-staff expertise and influence.
- Encourage emulation and testing, assuming the patient's perspective when making lighting and energy models and computer visualizations.
- Use a lifecycle perspective (30–50 years) from planning to product, exploring the lifecycle return on investment of design strategies for safety and workforce results.
- Positive results are linked with the involvement of clinical staff and community members with meetings, newsletters, webcams and other tools.

2.2.3 Tools

Evidence-based design has been applied to efficacy measurements of a building's design, and is usually done at the post-construction stage as a part of POE. The POE assesses strengths and weaknesses of design decisions in relation to human behavior in a built environment. Issues include acoustics, odor control, vibration, lighting and user-friendliness, and are binary-choice (acceptable or unacceptable). Other research techniques, such as observation, photography, checklists, interviews, surveys and focus groups, supplement traditional design-research methods. The Center of health design has developed assessment tools for Health Design and the Picker Institute to help healthcare managers and designers gather information on consumer needs, assess their satisfaction and measure quality improvements (wikipedia, 2015):

- The Patient Environmental Checklist assesses an existing facility's strong and weak points. Patients and their families on a 5-point scale evaluate specific environmental features, and the checklist quickly identifies areas needing improvement.
- The Patient Survey gathers information on patients' experiences with the built environment. The questions range is wide, since patients' priorities may differ significantly from those of administrators or designers.
- Focus Groups with consumers learn about specific needs and generate ideas.

2.2.4 Evidence-Based Design and Healing Environment

The Center for Health Design (2009) has clearly defined (EBD) as "the process of basing decisions about the built environment on credible research to achieve the best possible outcomes". A few years ago, little research existed to indicate the connection between healing environments and positive patient. There is now a growing body of research with more than 1,000 papers relevant to the relationship of design to outcomes, including topics such as patient safety and stress reduction for patients and staff.It is

now widely recognized that well-designed physical settings play an important role in making hospitals less risky and stressful, promoting more healing for patients, and providing better places for staff to work (Malkin, 2008).

The concept of healing has broadened dramatically in the last century; this has resulted in striking changes in the design of healthcare environments and a positive effect on the healing process of individuals. In the past, the design of healthcare environments was targeted mainly for the benefit of physicians and nurses; however, the central focus of environmental design today is directed toward patients and their families. Subsequently, staff have reaped the benefits of working in these improved surroundings. To ensure the designs remain effective, those who plan and design healthcare spaces remain attentive to any evidence that verifies the effect of healing environments on patients, their families, and healthcare personnel (Malkin, 2008).

2.3 Healing Environment

The concept of healing environments is not new. The idea of the environment contributing to healing goes back to more than 2000 years ago, but it recently this idea applied in the design and construction of health centers (Kamali & Abbas, 2012).

In another definition, a healing environment is where health and well-being are promoted, and where people are supported and nursed in a way that they feel spiritually calm. It is an essential part of preserve a healthy lifestyle and is just as critical as eating properly, exercising regularly, practicing appropriate health care, and having significate relationships. Specific design elements, such as cultural and age-specific details needs to be considered for creating a healing environment (Young & Koopsen, 2009).

The original concept of the healing environment was developed by Florence Nightingale whose theory of nursing called for nurses to manipulate the environment to be therapeutic (Nightingale, 1859). Nightingale outlined in detail the requirements of the "sick room" to minimize suffering and optimize the capacity of a patient to recover, including quiet, warmth, clean air, light, and good diet. Early healthcare design followed her theories outlined in her treatise (Nightingale, 1860).

An optimal healing environment (OHE) is a system and place composed of people, behaviors, treatments, and their psychological and physical parameters. See table (2.1). Its purpose is to provide conditions that stimulate and support the inherent healing capacities of the participants, their relationships, and their surroundings (AACN, 2007).

According to the Samueli Institute Nursing, an OHE, 2009 supports and stimulates patient healing by combining one or more of the following approaches: developing healing intention, experiencing personal wholeness, cultivating healing relationships, practicing healthy lifestyles, applying collaborative health care, creating healing organizations, and building healing spaces. A graphic of the OHE framework appears in table (2.1) (Smith, Firth, Ananth, & Reece, 2009).

Healing spaces is a physical environment, including the visual esthetics, sound, music, smell, taste, lighting, air, art, water, horticulture, architecture, and conditioning processes that support and stimulate recovery and repair processes (AACN, 2007).

Table 2.1: Optimal Healing Environments Framework. Source: Smith, Firth, Ananth, & Reece, 2009

Developing Healing Intention	ENHANCE AWARENESS	Experiencing Personal Wholeness	ENHANCE INTEGRATION	Cultivating Healing Relationships	ENHANCE CARING	Practicing Healthy Lifestyles	ENHANCE HABITS	Applying Collaborative	ENHANCE MEDICAL CARE	Creating Healing Organizations	ENHANCEPROCESS & STRUCTURE	Building Healing Spaces	ENHANCE SENSORY INPUT
													
Expectation		Mind		Compassion		Diet		Conventional		Leader-ship		Nature	
Hope		Body		Empathy		Exercise		Complementary		Mission		Color	
Understanding		Spirit		Social Support		Relaxation		Traditional		Culture		Light	
Belief		Energy		Communication		Balance		Integrative		Team-work		Art-work	
										Technology		Architecture	
										Evaluation		Aroma	
										Service		Music	
INNER ENVIRONMENT								OUTER ENVIRONMENT					

2.3.1 Goals of Healing Environment

The goal of all healing environments is to engage patients in the conscious process of self-healing and spiritual growth. Spaces are designed to be nurturing and therapeutic and, most important, to reduce stress. This is a research-based approach to design (also known as Evidence-based design), aimed at eliminating environmental stressors and putting patients in contact with nature in the treatment setting.

According to "The Business Case for Creating a Healing Environment" written by Jain Malkin, 2003 the physical setting has the potential to be therapeutic if it achieves the following (Malkin, 2003):

- Eliminates environmental stressors, such as noise, glare, lack of privacy and poor air quality;
- Connects patients to nature with views to the outdoors, interior gardens, aquariums, water elements, etc.;
- Offers options and choices to enhance feelings of being in control - these may include privacy versus socialization, lighting levels, type of music, seating options, quiet versus 'active' waiting areas;
- Provides opportunities for social support - seating arrangements that provide privacy for family groupings, accommodation for family members or friends in treatment setting; sleep-over accommodation in patient rooms;
- Provides positive distractions, such as interactive art, fireplaces, aquariums, Internet connection, music, access to special video programs with soothing images of nature accompanied by music developed specifically for the healthcare setting; and
- Engenders feelings of peace, hope, reflection and spiritual connection and provides opportunities for relaxation, education, humor and whimsy.

Others represented another benefits for healing environment, study explain how incorporating elements that produce a healing environment is not only good for patients, but also a good business strategy for healthcare providers to sustain or gain a competitive edge. The cultivation of a healing environment improves the healing experience for patients and families while simultaneously boosting the bottom line for healthcare providers by decreasing length of stays, improving patient outcomes, increasing family and staff satisfaction, decreasing staff turnover, and attracting new patients and competent staff. A healing environment can still be created in areas where the environment cannot be physically changed or modified. Critical care nurses and other personnel can make an environment toxic or healing based on their behavior. A nurse’s attitude toward patients and others influences the overall environment in the ICU (Kaplow & Hardin, 2007).

2.3.2 Theoretical/Philosophical Foundation for Healing Environments

In ancient cultures, manipulating the environment to place the body in the best position to heal itself was often the only strategy available. There are 2 models to explore in creating healing environment today: cultural and organizational models (AACN, 2007).

a. Cultural Models

There is a rich history of healing models from several cultures. The ancient medicine of Indian cultures, Ayurveda, describes access to a universal consciousness through meditation and intention that restores order and health to persons and communities. The traditional Chinese medicine considers the life energy responsible for health, illness, and healing. American Indians used specific rituals and altered states of consciousness to manipulate spiritual forces thought to be the cause of illness.

To create healing environments there must be an organizational philosophy and commitment to structuring the resources to support the philosophy and to focus on integrating science and spirituality. There is five common components of organizational healing models (AACN, 2007):

1- Common values of health as a function of body –mind- spirit interrelationships
2- Patient-centered relationships
3- An organizational culture that supports personal growth and mastery
4- The availability of alternative therapies in addition to conventional health care therapies
5- A physical environment that supports healing.

b. Organizational Healing Models

Organizational healing models require a multidisciplinary team approach to achieve desired outcomes. Patients tell us that communication among team members is often remembered and that it can continue to affect the patient even after discharge. Several studies specific to the critical care environment demonstrated that physician-nurse collaboration was a significant factor is decreasing predicted mortality and morbidity, decreasing staff turnover, and increasing patient and staff satisfaction with care.

Nursing presence is also a key element to the patient's outcome. There are six features of nursing presence that compose the context of nursing judgment (AACN, 2007):

1- Uniqueness
2- Connecting with the patients experience
3- Sensing
4- Going beyond scientific data
5- Knowing what will work and when to act
6- Being with the patient

2.3.3 Strategies for Promoting a Healing Environment

There are two environments of strategies for promoting healing environment such asphysical and social environment, as shown in table (2.2).

Table 2.2: Strategies for Promoting a Healing Environment. Source:Kaplow & Hardin, 2007
Physical Environment
• Reduce environmental stress caused by noise, offensive light, and odor
• Establish an official policy on noise standards and evaluate noise levels
• Use a mini-workstation to disperse staff
• Use sound-absorbent materials such as acoustical ceilings and carpeting in high-traffic areas
• Construct single rooms with televisions with headphones
• Test equipment for noise impact and implement a maintenance program
• Use natural light when possible
• Provide full-spectrum light
• Provide periods of low light for sleep
• Position the patient to appreciate the view
• Utilize calming color schemes such as blues, greens, and violet
• Incorporate nature and artwork
Social Environment
• Create a family friendly program
• Include the family in the plan of care
• Establish a liberal visiting policy
• Offer options to give the patient control over temperature, lighting, music, visitors, and privacy
• Design the area to accommodate families Healing Measures
• Therapeutic music
• Psychoacoustic therapy
• Nature sounds
• Therapeutic artwork
• Aromatherapy
Other Concepts
• Pet therapy
• Performing arts
• Hypnosis
• Prayer and guided imagery
• Therapeutic touch
• Yoga and reki
• Unit and organizational culture
• Architectural design

A. Physical Environment

a. Environmental Noise

Noise is one of the most insidious environmental stressors found in the hospital environment. On any patient room, harmful noises can include the steady of medical equipment, pagers and intercom systems, staff conversations, opening and closing of doors and even the clattering sounds from the wheels of a passing cart. These unusual and not expected noises can cause alarm to anyone, but especially a patient stressed from a physiological strain. A situation barrage of not expected noises has physiological manifestations as well, such as interrupted sleep (Kaplow & Hardin, 2007).

Individuals who were subjected to critical care sounds understood their sleep quality less positively than individuals who roomed in quieter environments. Designing a healing environment by reducing noises takes into consideration, many design elements, such as flooring, ceiling material and doors and nursing station placement (Topf, Bookman, & Arand, 1996).

By creating mini workstation out of the unit to minimize noise from conversations. Other design proposals include small beside televisions with a pillow speaker. Biomedical testing of patient care equipment for noise development of maintenance programs that review working quieter operation of equipment are also recommended to decrease noise level (Petterson, 2000). Other measured the noise level in two ICUs they found a peak noise level of 80 decibels and almost 50% of harmful noise generated was created by human behavior (Kaplow & Hardin, 2007).

Creating a culture among the staff that promote a healing environment includes encouraging behaviors, which decrease not necessary noise, such as avoiding over-the-bed conversations; turning pagers to vibrate; avoiding the use of overhead paging; turning off unused biomedical equipment; and modifying or repairing unnecessarily loud equipment. Beside staff behaviors that decrease unnecessary and harmful noises, therapeutic sounds can be introduced, such as heartbeat sounds music, music, and pleasant sounds from nature like ocean waves and rain showers (Kaplow & Hardin, 2007).

b. Environmental Light

Lighting eighty percent of what we understand our surroundings comes to us from what we see on our environment which affected by the light in that environment. Lighting design in healthcare environment is a basic factor in creating healing situations (wikipedia, 2015)

It is proven that people who are surrounded by natural light are more productive. One study involving schoolchildren and the effects of standard cool-white fluorescent light and full-spectrum showed that the children in the classroom with full-spectrum lighting achieves both academic and behavioral improvement after one month. In addition, study showed that classrooms with the cool-white florescent lighting had more

children with hyperactivity fatigue, and attention problems. Beside, full-spectrum light create less reaction to cortisol and Adrenocorticotropic hormone(ACTH) stress hormones. Full-spectrum light is best derived from natural daylight and can be achieved through windows, skylights, and atriums. Climate and sunlight influence a patient's length of stay. One study of unipolar and bipolar disorder patients demonstrated a decreased length of stay of 3.67 days when patients were assigned a brighter room (Ulrich & Zimring, 2004).

c. Color in the Environment

Because of the relationship between light and color, it cannot exist without the other. In fact, light and color promote each other's life and energy. There are seven colors in the visible spectrum of light: red, orange, yellow, green, blue, indigo, and violet; all of these colors are present in visible light. The energy of color is derived from light, and that energy generate both psychological and physiological responses in the body. Cortical activation, the autonomic nervous system, and hormone activation in body and mind was affected on color. Color evokes emotional responses that produce feelings of agitation or serenity that can alleviate aggravate or aggravate stress (see **Table 2.3**for the human's responses to color). Color can also affect an individual's emotional state, inducing cheerfulness, and calmness (Kaplow & Hardin, 2007).

Table 2.3: Human Response to Color. Source: Kaplow & Hardin, 2007

Color	Common Association	Nature Symbol
Red	High energy, passion, excitement raised blood pressure	Earth
Orange	Emotional expression, warmth	Sunset
Yellow	Optimism, clarity, intellect, mood enhancement, excitement, aging	Sun
Green	Healing, nurturing, unconditional love	Growth
Blue	Relaxation, serenity, loyalty, calming, healing	Sky and ocean
Indigo	Meditation, spirituality	Sunset
Violet	Spirituality, stress reducer, feeling of inner calmness	Violet flower

Over the centuries, many cultures have used color for its healing powers. Ancient Egyptians built chambers to produce a ray of prism light used for healing the sick. Also in Indian culture, each color is assigned to various energy centers of the body. Color has electromagnetic energy that can influence healing in similar ways to sunlight. Blues, greens, and violet have healing and calming influences and are stress-reducing colors, so they are appropriate using in a healthcare. Nevertheless, red, orange, and yellow colors should be avoided, because they increase blood pressure, induce excitement, and can cause fatigue. As another technique for using color in the environment, other suggests painted ceilings for patients to view while they are lying in bed (Kaplow & Hardin, 2007).

d. Environmental Landscape

In one study, postsurgical patients recovered more quickly when they had a room with a window view than other without this view, so suggested that changing the healthcare landscape had a positive effect, such as reduces stress and medical outcomes, including reductions in length of stay and speed of recovery. During Ernesto Machado's, father hospitalization in a cancer care center. Machado spent many hours in a windowless waiting area, where the colored ceiling and the lack of a good view scared him. This situation inspired him to develop a product "virtual window" that would simulate a window view for healthcare facilities actually looks like a window. It can be fixed in the wall or ceiling to bring the healing power of water and nature into the stressful hospital environment (Ulrich R. , 1984).

e. Air Quality

The sense of smell is more linked with the memory and emotions than any of the other. The effect of smell stimulates actions and reactions at both conscious and subconscious levels. This effect of an odor related with memories embedded deep within the human mind and spirit is known as the Proust phenomenon. The phenomenon is named after the French author, who described how the smell of tea-soaked cake changed his feelings from a gloomy frame of mind to the pleasant state of happy childhood. In addition, found that perception of odor not only evokes memories of happiness and sadness, but also that some odors can alert us to the danger of fire and stimulate our appetite. Another example of the Proust effect is the unbounded role the sense of smell plays in bonding between a new mother and her baby. New mothers unconsciously touch their babies' noses, breathing in their babies' smell, which helps in strengthen the mother–baby bond (Buckle, 2001).

The sense of smell plays important role in how individuals understand and react to their surrounding environments. The basic medicinal smells of a hospital environment made strong reactions, such as produce anxiety and increase heart rate and respiration. Controlling the many stress-producing smells in the critical care setting can be difficult task. One key is designing critical care units with a good ventilation to provide good air as well as single private rooms that eliminating the variety of odors a roommate may emit. Other suggestions removing unpleasant odors from the environment as quickly as possible and providing other, more pleasant odors to replace the noxious ones, such as vanilla, lavender, and mint (Kaplow & Hardin, 2007).

f. Liberalizing Family Visitation

As well, the impacts of the physical environment on healing environment, social support is a key component of the social milieu. Social support involve emotional, active support gave by family, and friends that is effective that may be influential in patient's recovery. Remove restrictions on family visitation for that significantly sick is a developing idea in giving a holistic methodology to healing. Historically, hospitals had restrictive strategies constraining family visits. Over time, many hospital wards have remove restrictions on visiting policies. Bay and by, many ICUs keep up restrictive visiting policies.

Empirical literature explain that visits from family decrease physiological stress in the critical ill but the opposite effect is unfounded, while nursing visits as often as possible increment physiological parameters, patients are regularly calmer and also demonstrate lowers with blood, pulse and intracranial pressure with family member trips. There may be times when families asked to leave or the ward is closed, such as during procedures emergencies, so open visiting may not be suitable for all patient. Family member's reputation through treatments and emergencies is currently being encouraged. Family provide your spiritual and emotive assist to be able to sufferers in an unfamiliar situation, and they can help give importance and understanding of the knowledge of sickness for the patient. Enabling the affected person to manage his or her very own viewing hours is imperative to a healing environment (Kaplow & Hardin, 2007).

2.3.4Comparison between Traditional and Healing Critical Care Environment.

The following table (2.4) showing a comparison between traditional and healing critical care according to physical, social environment and healing measure.

Table 2.4: The Critical Care Environment. Source: Kaplow & Hardin, 2007

Traditional	Healing
Physical Environment	
➢ Designs are utilitarian/sterile ambiance	➢ Incorporates color and architectural interest
➢ Lack visual interest or esthetic appeal	➢ Designs are based on patient's needs
➢ Noisy and chaotic	➢ Designed to limit noise with carpet and acoustical tiles
➢ Limits natural light or window view	➢ Full-spectrum lighting Incorporates natural light
➢ Limits privacy and family presence	➢ Private rooms and family welcoming
➢ Limits patient's control	➢ Offers option to give patient control over light, temperature, and visiting
➢ Restrictive visiting policy	➢ Liberalized visiting policy
Social Environment	
✓ Passive role for patient and family	✓ Holistic with active involvement of patient and family
Healing Measures	
- Allopathic - Symptomatic treatment - Lacks connection between patient's experience and treatment plan	- Integrates complementary therapy - Incorporates body, mind, and spirit - Connects patient's experience and treatment through music, art, and aromatherapy

2.4 Healthcare Definition

Health care is the diagnosis, treatment, and prevention of disease, illness, injury, and other physical and mental impairments in human beings. Practitioners in allied health, dentistry, midwifery (obstetrics), medicine, nursing, optometry, pharmacy, psychology and other health professions deliver health care. It refers to the work done in providing primary care, secondary care, and tertiary care, as well as in public health.

Access to health care varies across countries, groups, and individuals, largely influenced by social and economic conditions as well as the health policies in place. Countries and jurisdictions have different policies and plans in relation to the personal and population-based health care goals within their societies. Health care systems are organizations established to meet the health needs of target populations. Their exact configuration varies between national and subnational entities. In some countries and jurisdictions, health care planning is distributed among market participants, whereas in others, planning occurs more centrally among governments or other coordinating bodies. In all cases, according to the World Health Organization (WHO), a well-functioning health care system requires a robust financing mechanism; a well-trained and adequately paid workforce; reliable information on which to base decisions and policies; and well-maintained health facilities and logistics to deliver quality medicines and technologies (WHO World Health Organisation, 2015).

2.4.1 Healing Environment in Healthcare

In healthcare buildings, where patients seek medical treatment and staff provides continuous support, creating a healing environment with appropriate physical aspects is an imperative to sustainable design.

Nevertheless, the restoration of health and well-being is not merely a matter of physical science. The aspects of healing environment in hospital design are primarily important and relevant within the context of sustainability in healthcare facilities. The term ‘Healing Architecture’ is adopted to invoke a sense of a continuous process; in creating an environment physically healthy and psychologically appropriate. A healing environment with appropriate physical aspects would indirectly contribute to patients’ outcome such as shorter length of stay, reduced stress, increased patients satisfaction and others. One may agree to the idea that sustainable hospital design in the form of healing environment is achieved if these measurable outcomes could be quantified through appropriate design of physical aspects. Apparently, most scholarly literature does acknowledge that the existing physical environment we live in has an effect on our well-being (ARIPIN, 2007).

Most healthcare designers accept the fact that designing a hospital is a complex task: both functional and psychological. Apart from building services, healthcare designers are expected to conform to various requirements provided by the Ministry of Health (MOH), which includes medical specialist requirements and equipment both for diagnostics and for treatment. In the effort to comply with the explicit requirements, it seems that most healthcare designers pay less attention to the ultimate aim of creating a healing environment. This has well documented in most scientific literature that modern hospitals designed and equipped with technology for diagnostics, curing and treating have

contributed to stress, depression and anxiety, which have a harmful effect on health to patients and staff. On the other hand, adverse experiences of existing hospital environment recorded from visitors by the Commission for Architecture and the Built Environment (CABE) in the United Kingdom (CABE, 2004) and from patients' memories by Simini (1999). Critique would include terms such as confusing, dull, shabby, windowless, long circulation, glare and little natural light, poor lighting, noisy; sleep deprivation, isolation, physical restraint and want of information. As a response to this, most literature in the healing environment have outlined that noise control, air quality, thermal comfort, lighting, communication, colour, texture, privacy and view to nature are among the physical factors which have to be thoroughly considered in hospital design. These factors have a more pronounced influence in hospitals than in other buildings especially for patients who are bedridden or have limited freedom of movement (ARIPIN, 2007).

Established in a scientific study of a suburban US hospital that surgical patients who had view of nature through a window from their ward room not only spent less time in the hospital but required less analgesic medication as well. This study has spurred further tests and reviews by other disciplines involved with healing environments. They arrived at similar findings particularly that appropriate physical environment in the design of hospitals can ensure better health outcomes to patients, staff and visitors physically, mentally and psychologically. In short, careful consideration of the physical aspects would significantly contribute to create a better healing environment, which brings about sustainable hospital design (Ulrich R. , 1984).

A healing environment for healthcare buildings describes a physical setting and organizational culture that supports patients and families through the stresses imposed by illness, hospitalization, medical visits, the process of healing, and sometimes, bereavement. Healing environments enable patients and families to cope with and transcend illness. Spaces are designed to be nurturing and therapeutic, and most importantly, to reduce stress by connecting patients with nature in the treatment setting (Kellert, Heerwagen, & Mador, 2008).

2.4.2 Same-Handed Rooms (Standardization)

Same-handed rooms feature an identical, repeated layout, meaning the patient bed, technology, caregiver space; family space, bathroom, and hand washing sink are in the same location in every room. Based on standardization principles used in manufacturing and the airline industry, same-handed rooms encourage intuitive processes in patient care. The opposite of same-handed rooms are mirrored rooms. With mirrored rooms, the headwall of the patient in one room is shared with the headwall of the patient in the adjacent room. The headwall has multiple penetrations for items such as medical gas, lights, communication

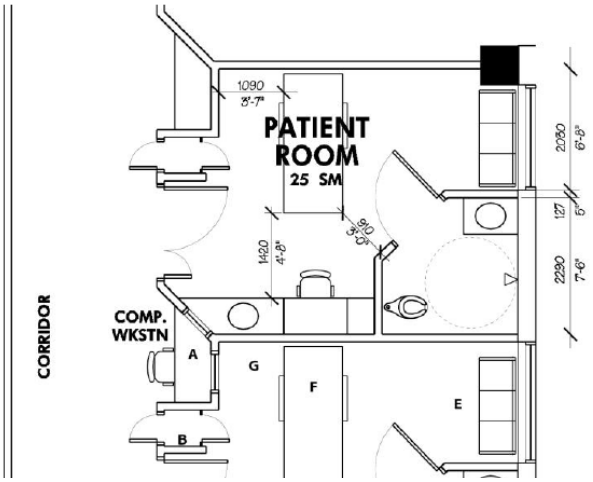


Figure 2.4: Schematic diagram demonstrating up-to-date design features. Source: McMullough, 2010

equipment, data jacks, and switches. Every hole allows sound to enter a room. Other found same-handed rooms limit noise (something that is measurable) because they have fewer penetrations in the walls between rooms.

Inside the door, visible to all who enter and to the patient. The patient bathroom (D) is located outboard and on the footwall in this configuration. This preserves the patient's view to the outside from the bed. If the bathroom were located on the headwall, the configuration of the room would be slightly different to allow the patient a view from the bed. The family space (E) is located near the window and away from the entrance to the room so staff members have clear access to the patient. The patient space is designated as (F). Caregiver space on the inside of the patient room (G) is to the right of the patient server (McMullough, 2010).

2.5 Conclusion:

After introducing the principle and strategies for EBD and healing environment. The outcome presents the important of the EBD in promoting healing environment and health outcomes that support and stimulate recovery and repair processes. The technique of EBD depended on patient comfort and caregiver performance. Moreover, to evaluation EBD design process must be use the POE. Which assesses strengths and weaknesses of design decisions in relation to human behavior in a built environment. In addition, gather information on consumer needs, assess their satisfaction and measure quality improvements.

The chapter concluded that the concept of healing environments is not new but recently it applied in the design of healthcare. Moreover, by physical and social environment strategies the healing environment will promote and improves the patients' well-being. One of the issues that investigate is lighting, which includes use natural lighting, provide full-spectrum light, provide periods of low light for sleep, design by based on patient's needs and offers option to give patient control over light to promote healthcare environment. Therefore, the next chapter will displays the lighting in patients' room and the effects of lighting on patients' well-being.

Chapter 3

Lighting in healthcare

3.1 Introduction

One of the most significant factors in a healing environment is lighting. Lighting is critical to human functioning in that it allows patient to see things and perform activities. Moreover, it is important because it affects patient beings psychologically and physiologically.

This chapter will display an overview of lighting and its color and appearance of lighting color such as color rendering Ra and color temperature CT. It will highlight the types of light in healthcare. In addition, it will explain the consideration of lighting design, which include lighting quantity and quality then describe the main key and roles for patient rooms to supports healing environment. In addition, it will display examples of new lighting solution of patient room with the best lighting design and sources. Finally, it will discuss the effect of lighting on patient well-being that includes Visual, Biological and Psychological effects.

3.2 Lighting Basics

3.2.1 Lighting Definition

Lighting Is defined as the part of the electromagnetic spectrum that is seen by our eyes and its wavelength range is between 380 and 780 nm. See figure (3.1) (Zumtobel Lighting, 2013).

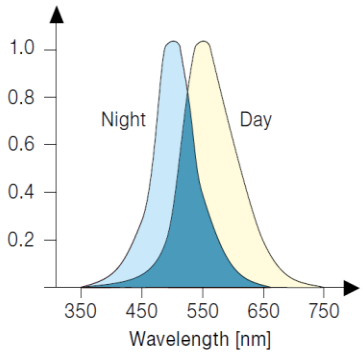


Figure 3.1: wavelength range for lighting. Source: Zumtobel Lighting, 2013.

Beyond red is infrared radiation, which is invisible to the eye but detected as heat. At wavelengths beyond the violet end of the visible spectrum, there is ultraviolet radiation that is also invisible to the eye; to it can damage the eye and the skin. White light is a mixture of visible wavelengths, as is demonstrated for example by a prism which breaks up white light into its constituent colors as illustrated in figure (3.2)(Philips Lighting Academy, 2008).

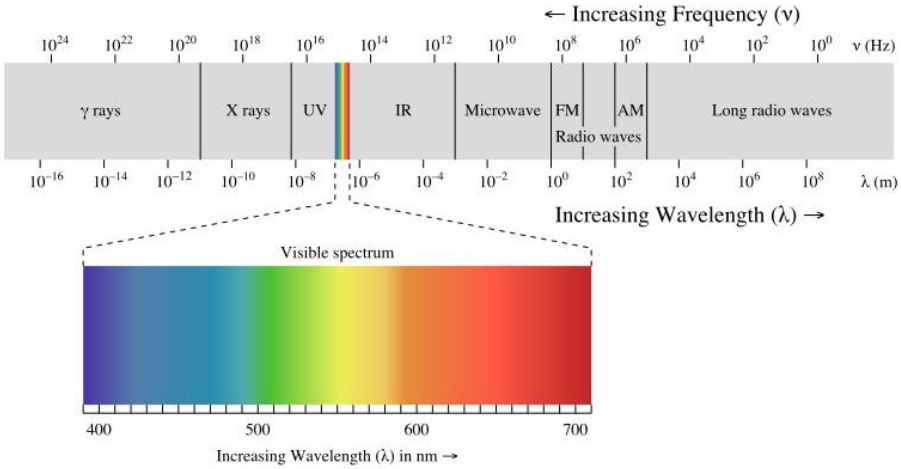


Figure 3.2: Electromagnetic spectrum. Source: Wikipedia, 2001

3.2.2 Basic Parameters used in Lighting

Figure (3.3) shows There are four basic photometric units that lighting practitioner's use for the quantitative measurement of light:

1- Luminous flux Φ

This expresses the total quantity of light radiated per 1 second by a light source. The unit of luminous flux is the *lumen (lm)*

2- Luminous intensity I

This defined as the flux of light emitted in a certain direction. The unit of luminous intensity is the *candela (cd)*

3- Illuminance E

This is the quantity of light falling on a unit area of a surface. The unit of illuminance is lumen/m2, or *lux (lx)*

4- Luminance

This describes the light emitted from a unit area in a specific direction. The unit of luminance expressed in *cd/m2* (apparent surface) (Philips Lighting Academy, 2008).

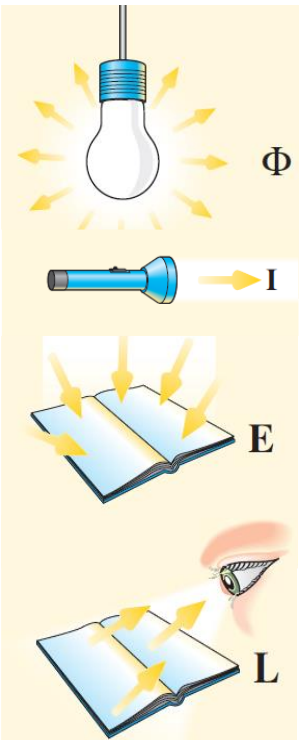


Figure 3.3: Basic para-meters used in lighting. Source: Philips Lighting Academy, 2008

3.3 Lighting and Color

3.3.1 Color Definition

Color is not a physical property of the things we see, it is the consequence of light waves bouncing off or passing through various objects (FIES, 2003). So contrary to popular belief, "color" is not really an intrinsic property of the things we see around us. As illustrated in figure (3.4). Rather, it is the sensation resulting from a given spectral distribution of light, detected by the three color-sensors in the eye and interpreted by the brain (Steer, 2008). As Newton said that light identified as the source of the color sensation (Derksen, 2001).

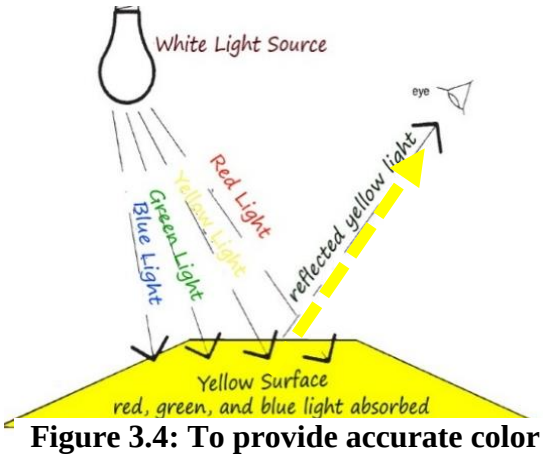


Figure 3.4: To provide accurate color rendition, the light source must emit the wavelengths that the object reflects.
Source: FIES, 2003

Color is something that happens in the human seeing apparatus when the eye perceives certain wavelengths of light. There is no mention of paint, pigment, ink, colored cloth or anything except light itself (Bellman, 2001).

When light falls on the retina, it creates a photochemical reaction in the rods and cones at the back of the retina. The reactions then continue to the bipolar cells, the ganglion cells, and eventually to the optic nerve. As illustrated in figure (3.5)(Stangor, 2011).

The color of a light source depends on the spectral composition of the light emitted by it. (Philips Lighting Academy, 2008).So the light color describes the color appearance of the light (Zumtobel Lighting, 2013).

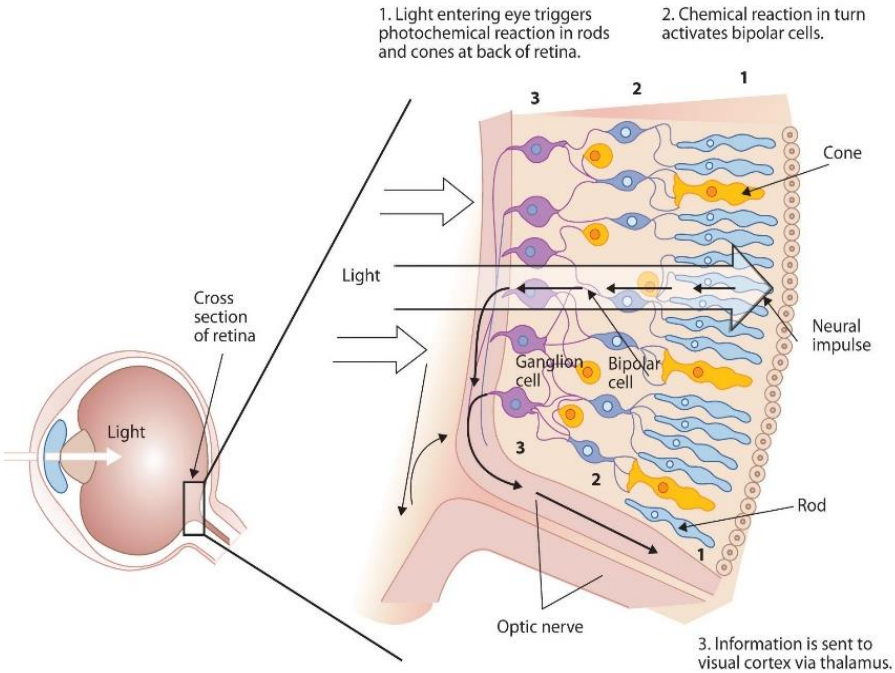


Figure 3.5: Cone-Receptors in the human eye source: Stangor, 2011

Table (3.1) shows Color temperature, Appearance, and Association for lighting color.

Table 3.1: Color temperature, Appearance, and Association for lighting color, Source: Zumtobel Lighting, 2013

Lighting color	Color temperature	Appearance	Association
ww(warm white)	up to 3300 K	Reddish	warm
nw(intermediate white)	3300–5300 K	White	neutral
cw(cool white)	from 5300 K	Bluish	cool

3.3.2 Light Colors Mixing

When colored light beams are mixed, the result will be brighter than the individual colors, and if the right colors mixed in the right intensities, the result will be white light. See figure (3.6). This known as additive color mixing. The three basic light colors are red, green and violet-blue. These are called the primary colors and additive mixing of these colors will produce all other light colors, including white (Philips Lighting Academy, 2008).

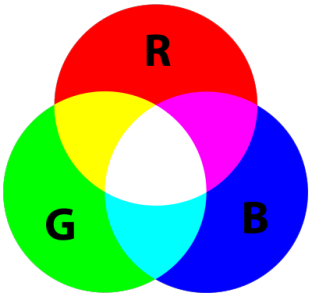


Figure 3.6: Light Colors Mixing. Source: Wikipedia, 2002

So: Red + green = yellow….Green + violet-blue = cyan (sky blue)

Red + green + violet-blue = white…. Red + violet-blue = magenta (purplish red)

3.3.3 Basic Definitions in Lighting Color

a. Color matching functions (CMFs)

Figure (3.7) shows the three International Commission on Illumination (CIE) color matching functions (CMFs) called Xbar, Ybar and Zbar, and for practical color matching and display applications, these can treated as if they were the spectral response curves for the cone-receptors in the human eye (Steer, 2008).

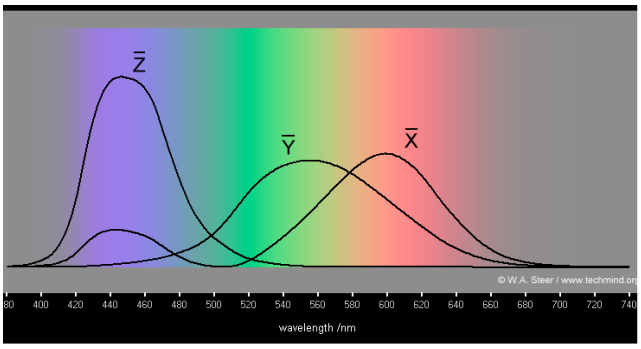


Figure 3.7: three CIE color matching functions (CMFs). Source: Steer, 2008

b. CIE Chromaticity diagram

Philips Lighting Academy, 2008 indicate that a graphic representation of the range of light colors visible to the human ocular perceiver noticeable through the CIE chromaticity diagram. Located saturated colors red, green, and violet in the corners of the triangle with the spectral color intermediates along the slant sides, and purple at the bottom. Go inside, they become lighter and weaken simultaneously..see figure (3.8) Triangle center -where all colors white meet. The color values are numerically plotted along the right-angled x- and y-axis. Thus, the definition of each color of the light by X- and values of y, which called chromaticity coordinates, or color point.(Philips Lighting Academy, 2008).

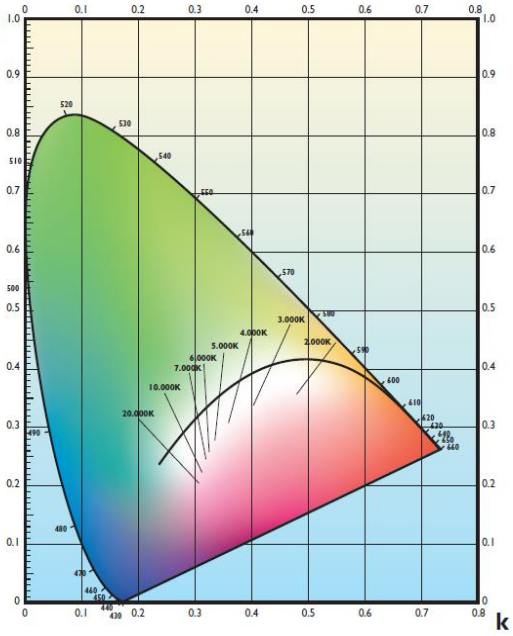


Figure 3.8: CIE chromaticity diagram. Source: Philips Lighting Academy, 2008

c. Spectral Power Distribution (SPD)

Figure (3.9)show the spectral energy distribution of the relative strength of the waves across the visible spectrum for a given light source. These graphs also reveal the ability of a light source to provide all, or, culled colors.

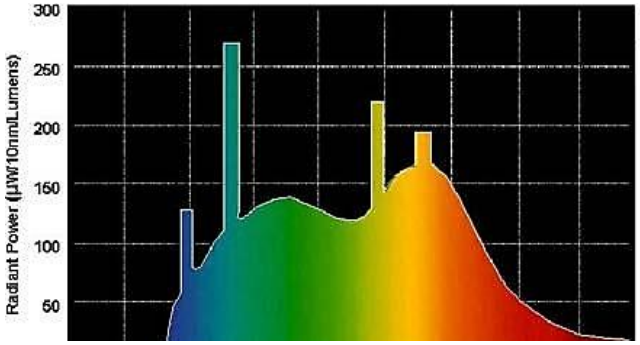


Figure 3.9 spectral power distribution graph for daylight. Source: cndlighting, 2012

You can choose a bulb with a color temperature of 3000k or 3500k, if you want high color rendering bulb to produce light perceived as warm white. If you want to provide high-quality color bulb to produce light perceived as white, choose a bulb with a color temperature of 4000K.Bulb that mimics daylight, and choose a color temperature of 5000K or higher. Use of incandescent bulbs are coated bulbs with neodymium. However, these lamps (cndlighting, 2012).

3.3.4 The Appearance of lighting Color

a. ColorRendering

It describes how a light source makes the color of an object appear to human eyes and how well subtle variations in color shades revealed (ALG, 2010).Color rendering is an important aspect of artificial lighting. In some situations colors should represented as naturally as possible as under daylight conditions, yet in other cases lighting should highlight individual colors or create a specific ambience. To classify light sources on their color rendering properties the so-called color rendering index (CRI or also denoted as Ra) has been introduced. The scale of the Ra ranges from 50-100(Philips Lighting Academy, 2008). The following table (3.2) shows the meaning of the Ra values:

Table 3.2: color rendering, Ra values, *Source:* Philips Lighting Academy, 2008	
Ra = 90 - 100	Excellent color rendering properties
Ra = 80 - 90	Good color rendering properties
Ra = 60 - 80	Moderate color rendering properties
Ra < 60	Poor color rendering properties

Table (3.3) Shows color rendering according to Index Ra.

Table 3.3:Color rendering index Ra,*Source:* Zumtobel Lighting, 2013						
Color rendering index Ra	≥90	80–89	70–79	60–69	40–59	20–39
Daylight	•					
Light Emitting Diode (LED)	•	•	•			
Halogen lamp	•	•				
Compact fluorescent lamp	•	•				
Fluorescent lamp	•	•	-	-	-	

b. Color temperature

Although white light is a mixture of colors, not all whites are the same since they depend on their constituent colors. Therefore, a white with a higher proportion of red will appear warmer and a white with a higher proportion of blue will appear cooler. This concept can best explained with the help of familiar thermal radiators like the filament of an incandescent lamp or an iron bar. When these materials heated to a temperature of 1000 K their color appearance will be red, at 2000-3000 K they will look yellow white, at 4000 K neutral white, and at 5000-7000 K cool white(Philips Lighting Academy, 2008).

The choice of color temperature being determined by the following factors (Philips Lighting Academy, 2008):

a. Ambience: warm-white creates a cozy, inviting ambience; neutral/ cool-white creates a business-like ambience.

b. Climate: inhabitants of cooler geographical regions generally prefer a warmer light, whilst inhabitants of (sub)-tropical areas prefer, in general, a cooler light.

c. Level of illumination needed.

d. Color scheme in an interior. Colors like red and orange shown to advantage with a warm-white light, cool color like blue and green look somewhat more saturated under a cool-white light.

The following table (3.4) shows examples of different color temperatures according to type of lighting.

Table 3.4:Examples of different color temperatures, Source: Philips Lighting Academy, 2008

Type of light	Color temperature (K)
Candles	1900 – 2500
Tungsten filament lamps	2700 – 3200
Fluorescent lamps	2700 – 6500
High-pressure sodium (SON)	2000 – 2500
Metal halide	3000 – 5600
High-pressure mercury	3000 – 5600
Moonlight	4100
Sunlight	5000 - 5800
Daylight (sun + clear sky)	5800 - 6500
Overcast sky	6000 - 6900

c. Correlated color temperature (CCT)

Correlated color temperature (CCT) is a measure of light source color appearance since it is a single number, CCT is simpler to communicate than chromaticity or SPD, leading the lighting industry to accept CCT as a shorthand means of reporting the color appearance of "white" light emitted from electric light sources. CCT values of most commercially available light sources usually range from 2700 K to 6500 K. CCT values are intended by the lighting industry to give specifies a general indication of the apparent "warmth" or "coolness" of the light emitted by the source. According to lighting industry convention, lamps with low CCT values (2700 K to 3000 K) provide light that appears "warm," while lamps having high CCT values (4000 K to 6500 K) provide light that appears "cool." (Lighting Research Center, 2004).

3.4 Types of Light in healthcare buildings

Combination of skylight and daylight that entering through windows and electric light source, needed for most healthcare facilities. These two kind of light sources are important to understand how those types of light source differ to understand their relative impacts on human health and performance (Joseph, 2006).

Lighting within the indoor environment can considered to have three basic purposes (Phillips, 2004):

- To allow the users to work and move about in safety.
- To allow tasks to performed.
- To make the interior look pleasant.

A building can lit in two principle ways. These are:

1. Naturally (Daylight) - by daylight received from the sky.
2. Artificially (Artificial lighting) - by electric lamps.

3.4.1Daylight

The objective of daylight design is to supply visual variety with controlled brightness contrasts. Variety is a principal characteristic of daylight. Cleanliness of the atmosphere, the inter reflection of surrounding objects are affecting on change of color of day light which it is change with time, the factors that affected on intensity of sun changes is time of day, the time of year and latitude of the site.

The amount of daylight pass within a room will be dependent (Phillips, 2004):

- The orientation, geometry and space planning of the spaces to lit.
- The dimensions and orientation of the openings through which daylight will pass through it. Figure (3.10) shows kinds of opening.
- The location and surface properties of any internal partitions that may reflect and distribute the daylight.
- The location, form and dimensions of any shading devices that will supply protection from too much light and glare.
- The light and thermal properties of the glazing materials used.

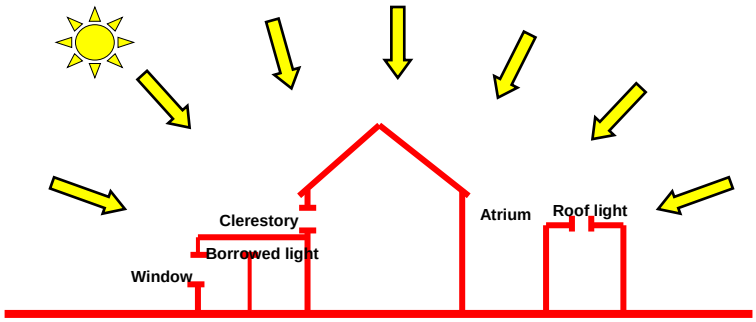


Figure 3.10: kinds of opening in building. Source: Phillips, 2004

a. Importance of day lighting in electrical lighting design:

There is procedures that used to minimize energy by using lighting Particular attention must be given to day lighting while designing a building lighting system according to:

- Day lighting used to increase visual comfort inside the buildings.
- Day lighting is used to decrease energy use by the following methods(electrical-knowhow, 2012):
    - Decreasing the use of artificial (electric) lighting by simply installing fewer electric lights
    - Using passive solar technology for heating or cooling different spaces inside the building.

b. Daylight Factor

Daylight factors are used to measure if the natural lighting levels in a space will be enough for the users of the space to perform their normal activities. It is the ratio of internal light level to external light level and defined as follows:

$$DF = (Ei / Eo) \times 100\%$$

- Ei = illumiance due to daylight at a point on the indoors working plane,
- Eo = simultaneous outdoor illuminance on a horizontal plane from an unobstructed hemisphere of overcast sky (Shikder, Mourshed, & Price, 2010).

Calculating daylight factors requires complex repetition of calculations and thus undertaken by a proprietary computer software. CIBSE Lighting Guide 10 (LG10-1999) which broadly bands average daylight factors into the following (electrical-knowhow, 2012):

- DF Under 2: Not adequately lit – artificial lighting will be required.
- DF between 2 &5: Adequately lit but artificial lighting may be in use for part of the time.
- DF Over 5: Well-lit artificial lighting generally not required except at dawn and dusk – but glare and solar gain may cause problems.

3.4.2Artificial lighting (illumination)

Lighting or illumination is the deliberate use of light to achieve a practical or aesthetic effect. Lighting includes the use of both artificial light sources like lamps and light fixtures, as well as natural illumination by capturing daylight. Daylight (using windows, skylights, or light shelves) sometimes used as the main source of light during daytime in buildings. This can save energy in place of using artificial lighting, which represents a major component of energy consumption in buildings. Proper lighting can enhance task performance, improve the appearance of an area, or have positive

psychological effects on occupants. Indoor lighting is usually accomplished using light fixtures, and is a key part of interior design. Lighting can also be an intrinsic component of landscape projects (Chia, 2003).

a. Artificial light sources

The five most common light sources are as follows (European Commission, 2012):

1. Incandescent lamp.
2. Compact fluorescent lamp.
3. Fluorescent tube.
4. Discharge lamps.
5. LED.

b. Types of Indoor Light fixtures /luminaires according to light function

There are five basic types of light fixtures according to the function or aim of using it as follows (electrical-knowhow, 2012):

1. Ambient (general lighting) 2. Task 3. Accent 4. Decorative lighting.

3.5 Lighting Design

3.5.1 Lighting Design Definition

"Design" is the science and art of making things that important to humankind. Lighting design means meeting requirements, which are practical. The activity of interior space is important to determine the visual task. Having more uniform illuminance is always, better colour rendering and less glare effect that what the standards specify because they will meet the requirement better. Exceeding the standard average of illuminance is not necessarily better; therefore, it not always approved. Having illuminance, that supply the required shadow effect advised to have as well as to have the recommended ratios of luminance. It is rarely advisable to deviate considerably from these ratios.(Majoros & Habil, 2011).

Good lighting design can met by the:

- Appropriate choice of light sources,
- Appropriate choice of luminaire,
- Appropriate number of luminaires,
- Suitable placing of luminaires in the room and
- Suitable form of the interior.

Based on the above, artificial lighting should be designed (Majoros & Habil, 2011):

1. Select the lamp because of the colour of light and the group of colour rendering.
2. Choose the luminaire because of its lighting characteristics.
3. Select the type of luminaire.
4. Determine the number of luminaires needed.
5. Install the luminaires in the room.

3.5.2 Design Considerations

a. Lighting Quantity "Task Illuminance"

For general lighting objectives, the recommended practice is to design for a level of illumination on the working plane because of the recommended levels for visual tasks given in CODES (NBC) by a method called 'Lumen method'. Moreover, make the necessary calculations concerning the type and quantity of lighting equipment necessary advance information on the surface reflectance of walls, ceilings and floors is required (ALG, 2010)**.**

b. Lighting Quality

Lighting affected human reactions strongly, this human reactions like the drama, beauty of an illuminated landmark or the emotional response of candlelight dinner to accurate impacts on worker productivity in offices or sales in retail stores.

There are three levels of lighting quality as illustrated in the following table (3.5)(Zumtobel Lighting, 2013)**:**

Table 3.5: Three levels of lighting quality, Source: Zumtobel Lighting, 2013

Visual requirements	Emotional requirements	Biological requirements
– Adequate visibility of details (visual acuity, contrast) – Adequate visibility of shapes (three-dimensional) – Adequate visibility of colors and color variations – Promptness of adequate visibility – Adequate visibility over time/visual performance – Guidance of attention – Order, differentiability – Physical safety – Object safety	– Spatial orientation – Keeping track of time – Orientation about what is happening – Privacy, communication – Personal territory – Self-representation, external representation – Justice – Sense of security – Self check – Mental stimulation – Mental recovery – Familiarity, surprise (no monotony) – Structuring space according to shapes – Structuring space according to rhythms (symmetries) – Structuring space according to modules – Enhancing the architecture's character and mood – Emphasizing special architectural (design) features	– Physical stimulation – Physical recovery – Circadian rhythms – Protection from radiation – Physiological effect

3.5.3 Lighting Design Considerations for the healthcare facilities

In healthcare facilities, lighting design and the technology behind it can be a matter of life and death. A well-designed system can lead to decreasing in medical mistakes, pain, stress, sadness, and time of stay, as well as help in a good night's sleep. By predicting the lighting needs of the patient and the medical staff, it is possible to achieve a healthy, cost-effective, and sustainable system (Alcaraz, 2009).

Patients will usually overcome for lighting requirements, while medical staff and maintenance crew need a diversity of illuminance levels. Therefore, Lighting must be pliable and adjust quickly. In healthcare facilities, light source and luminaires must often match specific requirements for safety of users and protection, specific sites and functions. Since hospitals typically contain large numbers of identical rooms, corridors and waiting areas, the lighting must help to create a means of finding one's way around. In addition, a large percentage of the hospital population, both patients and staff, may be seniors, so lighting design must accommodate the "aging eye". All these factors present challenges to the lighting designer (Osram Sylvania, 2013).

a. Healthcare Lighting Design Purpose

- The effectiveness of any building or infrastructure design is widely impacted by functional and operational quality.
- Lighting for health care facilities is about allowing patient comfort and caregiver effectiveness in a safe, trusted environment(Karlen, Benya, & Spangler, 2012)

b. Role of Healthcare Lighting Design (Ibid)**:**

- Address the occupants' needs
- allow visual tasks to be performed
- Align with preferable appearance of the space
- Supply infection control
- To be proper with energy/economic budgets
- Improve the built environment
- Enhance patient comfort
- Support the healing process
- Allow staff to perform
- Facilitate effective cleaning
- Reduce maintenance cost and burden.

c. The key design considerations for healthcare lighting (Osram Sylvania, 2013)**:**

- Lighting should be diverse along person's trip through the healthcare facility, offering visual interest and visual easement.
- Spaces should be glare-free and free of extreme contrasts of brightness, with attractive, layered and hidden-source lighting that establishes a comforting mood.

- Lamps from parabolic luminaires or brightly lensed troffers in corridors and patient rooms are distracting and visually discomforting.
- Indirect lighting is often desirable in these occasions.
- Where possible, day lighting and daylight harvesting should incorporated, both for therapeutic effect and for energy savings.
- Where medical staff is working at tasks, uniform light levels can promote operations and reduce fatigue.
- Where patient care and direct attention to medical procedures are superior. So too do the light color quality, intensity, location and tendency of luminaires.

3.5.4Lighting for Patient Rooms

Lighting for patients' rooms creates a design challenge because lighting requirements differ for patient, family, and staff needs. Because of the diversity of lighting levels required, flexibility is the key. Create multiple zones of light with simple switching. Daylight via a window needed in all patient rooms so the patient is oriented to the outside world a critical element in stress reduction. The American Institute of Architects (AIA) guidelines also suggest lighting controls for patients so they can have some control over their environment (AIA, 2006).

Therefore, the design considerations for patients room as following (Cooper Lighting, 2014)**:**

- System flexibility must allow the patient to have individual control with additional switching locations for the healthcare professional.
- Glare or excessive brightness must be eliminated in these spaces.
- Light trespass during sleep hours must be controlled to minimize exposure that can alter circadian rhythms.
- Nighttime monitoring and observation should be conducted with minimal disruptions (subdued red-amber light sources appear to positively affect melatonin).
- For good rendition of skin and tissue, a CRI of 80 or higher is recommended.

Patient room Standard

Figure (3.11) shows how to make a comfortable and warm setting, a luminaire with a gentle light and soft appearance has selected to meet the needs of patients and obey with requirements for patient rooms. In addition, the patient can control a wall-mounted reading light. In the evening, a down light above the table makes the space more open and inviting for visitors, plus an additional task light provided above the table (Philips, 2014).

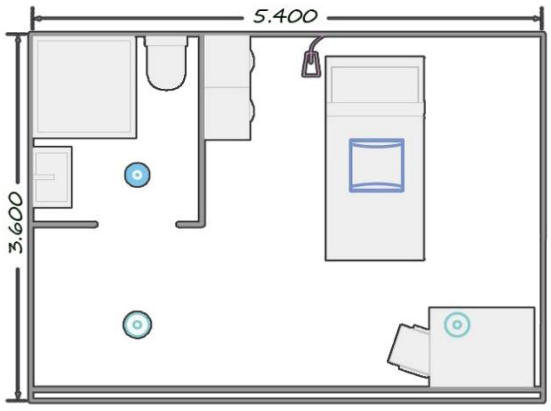


Figure 3.11 Plan view of a typical scheme (All dimensions in millimeters). Source: Philips, 2014

** There are luminaries that used in patient room which are shown in table (3.6)

Table 3.6: Luminaires used in Patient room, Source: Philips, 2014

ArcForm	**Dura Care**	**Greenspace**	**CoreLine Ceiling/wall**
			
			
General lighting •Soft and comfortable lighting, with full luminous surface • Wide beam shape allows for high uniformity and high vertical illuminance • Submissive with glare norms • Charming design • State-of-the-art LED technology for higher energy efficiency compared to similar conventional solutions	**Reading light** • Shielded low-voltage LED lamp • Glare-free light for visual comfort • Strong, compact design and easy to clean • Minimized heat emission due to twin-wall housing • Durable construction	**General lighting** • Cost-efficient and sustainable downright • Can be replaced conventional Compact fluorescent lamp (CFL) down lights • Features the latest LED technology • highly low power consumption • Stable color performance and high color rendering • Long lifetime of 50.000 hours and Lifetime (L80)	**Bathroom light** • A very Changeable luminaire, combining good value for money with great performance • Low energy use (including automatic turning off the light when no one's present) • Elegant, timeless design • Warmer/cooler color temperatures available

b.The key design considerations for Patient Room lighting

Patient room has many lighting design consideration that includes; space considerations, occupant needs, lighting requirements, lighting equipment and lighting quality for patient (DiLaura, Houser, Mistrick, & Steffy, 2011).

1- Space Considerations

- Room configuration and deliberated objective
- Furniture layout

- Windows & room Orientation
- Location of medical equipment, lift systems

2- Occupant Needs

Following table (3.7) showing, the occupant needs in patient room, which included patient and staff, needs.

Table 3.7: Occupant Needs in patient room, Source: DiLaura. et al. 2011

Patient	Caregiver Staff
• Reading/writing • Watching TV • Visiting with guests • Sleeping • Restroom	• Routine nursing • Surveillance of patients –24 hour • Night lighting • Patient examination

3- Lighting Requirements

Following table (3.8) showing lighting requirements for patients' applications and tasks.

Table 3.8: Recommended Maintained Illuminance Targets (In Footcandles, horizontal). Source: (DiLaura. et al. 2011)

Applications & Tasks	Visual Age of Observers (in years)		
	<25	***25-65***	***>65***
Examination	25	50	100
Reading	10	20	40
T.V watching	2.5	5	10
Shower	5	10	20
Vanities	7.5	15	30
Night Lights	0.05	0.1	0.2

4- Lighting Equipment

a) General Illumination
   - Low-brightness, diffuse recessed luminaires
   - Direct/Indirect lighting
   - Cove lighting

b) Task Illumination
   - Wall bracket
   - Wall sconce
   - Table lamps

c) Medical Task Illumination
d) Adjustable examination
e) Allow to improve a comfortable environment for patients.
f) Low-level night lighting

g) Mounted 12-18" above floor
h) Supplemental handrail lighting may be used
i) Long wavelength sources between 600-620nm (red-amber) are often recommended to prevent sleep cycle interruption, while enabling visual acuity (DiLaura. et al. 2011).

c. Lighting Quality for Patient

Table (3.9) shows the lighting quality for patient room

Table 3.9: Lighting Quality for Patient Room. Source: Zumtobel Lighting, 2013

Health and activity	Examples
Quality for patients and persons in need of care	– Taking into account dementia patients – Preventing mirror effects and reflections (delusions)
Feeling at ease and supporting the inner clock	– In many healthcare facilities, no daylight – an significant means of stabilizing the inner clock – is available – Little time is spent outdoors – Compensation by artificial lighting: well-adjusted changes in light colors and illuminance levels – High intensity in pools of light
Enhancing comfort and providing security	– Bedside lighting – Age-suitable lighting scene concept in line with healthcare requirements
Reliability and functionality	
Visual comfort and security for patients and residents	– Emergency lighting – Providing orientation – Preventing heavy shadows and dark zones – Nice corridor design using indirect light components on ceiling and walls
Supporting diagnosis and treatment	– Maximize in illuminance levels: at the press of a button at the patient's bedside or via additional light components – High color rendering index
Optimizing doctors' and nurses' working conditions	– Individual configuration, instinctive operation – Special illumination to meet high demands (operating theatres and intensive-care units) – Motivation of night shift workers through high illuminance Levels
Flexibility	– Modular lighting and medical supply units adapt flexibly to suit the way a room is being used
Eco-friendly and economically efficient	
Added value for operators and investors	– Daylight-based control and lighting scenes that can be called up individually enhance comfort and increase efficiency
Optimizing energy Consumption	– Efficient luminaires and light sources – Corridor lighting with presence-based control and LED – unaffected by frequent switching and dimming
Enhancing the health and care facility's image	– High-quality appearance of facade, parking spaces, entrance and waiting areas
Integral approach	– Central lighting control system with monitoring, including the emergency lighting system

3.6 A new lighting solution for patient rooms

3.6.1 A daylit

A daylit patient room uses light from the sky for daytime illumination, effectively reducing the need for electric light. The amount of daylight that comes into a room depends upon the area and location of the window and the amount of the sky the window "sees." The distribution of that light is a function of the window's shape and location in the window wall and the proportions of the room, room reflectivity, and obstructions within the space. As illustrated in figure (3.12)

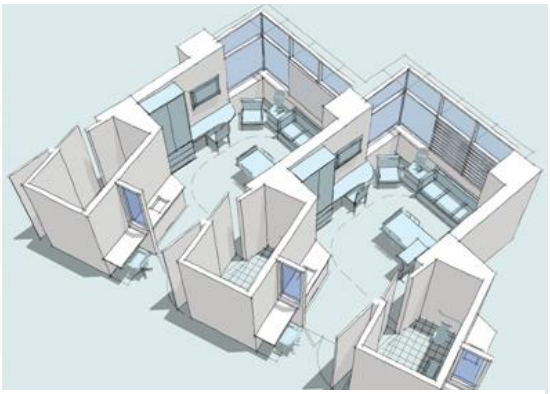


Figure 3.12: A daylit patient room. Source: Brown, et al., 2005

A patient room providing good outdoor views and daylighting can increase patient well-being: a psychological state resulting in reduced stress and anxiety, lower blood pressure, improved post-operative recovery, reduced need for pain medication and shorter hospital stays (Brown, et al., 2005).

A. Positioning the toilet room

Outboard toilet rooms, placed along the exterior wall, greatly reduce daylighting potential. See figure (3.13). For maximum daylighting benefit, toilet rooms should be located between two adjacent patient rooms (Ibid).

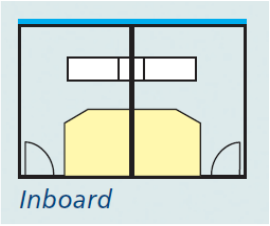


Figure 3.13: Positioning the toilet room. Source: Brown, et al. 2005

B. Room depth

The depth of the hospital room that can be usefully daylit is dependent on the size and head height of the daylight window, adequately daylit patient rooms, with inboard or shared toilets, ranged from 13 feet to 19 feet deep. Shallower rooms are most desirable, because they facilitate more even daylight distribution to the back of the room.

C. Daylight and view window differences

Daylight and view windows, in patient rooms, have different conflicting requirements, and the most straightforward design resolution is to separate these two windows and their functions.

In figure (3.14) shows, the daylight window provides ambient light. The view window, while also admitting light into the room, functions primarily as the patient's view to the outside, relieving stress, promoting relaxation, and even preventing delirium. The daylight window should be located with its head height as high as possible in the wall and should extend the full width of the room.

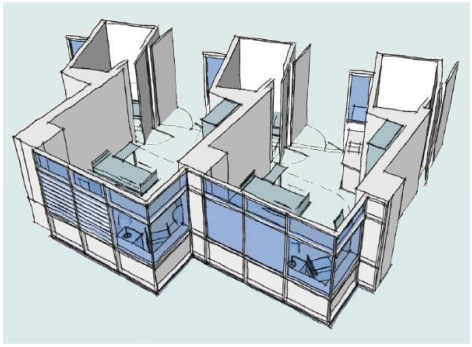


Figure 3.14: The daylight window. Source: Brown, et al., 2005

D. Glazing specifications

Daylight windows should have low u-values, low solar heat gain coefficients (SHGC), and high visible light transmission (VLT). Depending upon the climate and a room's aperture control capabilities, either the R-value or SHGC may be relatively more important. Because they not used for daylighting, view windows can have a lower visual light transmission, therefore, lower u-values, and lower SHGC.

E. The best window wall configurations

In plan, an angled window wall can have a different orientation than the rest of the building and potentially achieve better daylighting performance. If the window wall notched, or designed with a corner window, as illustrated in figure (3.15) the view window can have a different orientation than the daylight window.

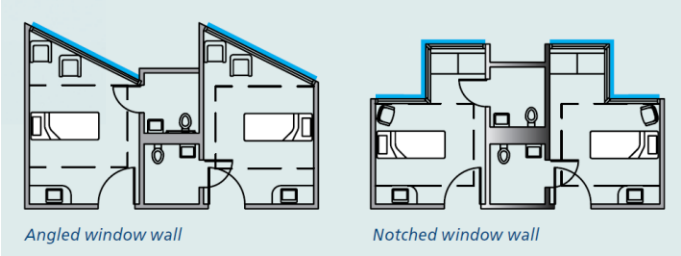


Figure 3.15: Angled window wall. Source: Brown, et al., 2005

3.6.2 Heal-Well

Heal-Well is a new light solution for patient rooms, developed specifically to address people's natural responses to light. It provides light that tuned to support the biological clock and creates a pleasant ambience for patients and visitors. See figure (3.16).Thus supporting the healing environment. Study carried out at the Maastricht University Medical Centre (MUMC) in the Netherlands (Philips, 2011).

Existing lighting – day

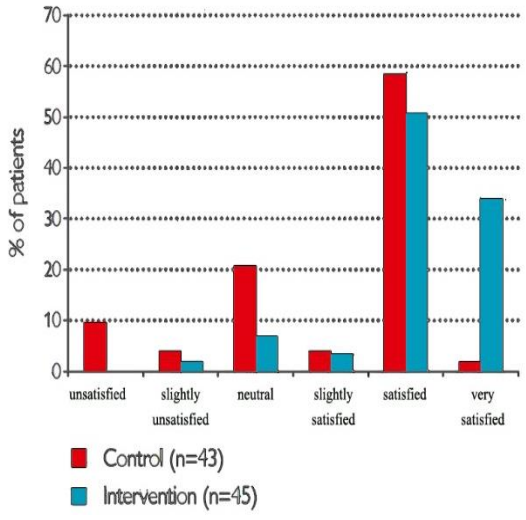
Existing lighting - evening

Heal-Well lighting – day

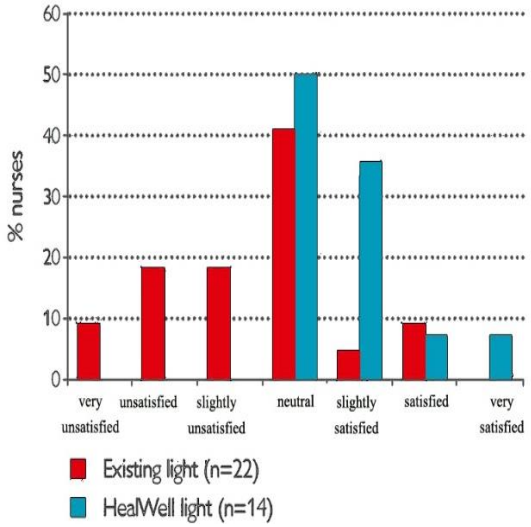
Heal-Well lighting - evening

Figure 3.16: Rooms at Cardiology Dept. Maastricht UMC, and the Netherlands (during the field study). Source: Philips, 2011

The study took place at the cardiology department of MUMC, where various outcome parameters of patients monitored during their stay in hospital. In the study, the results of patients in control rooms (with existing lighting) compared with those of patients in intervention rooms (with Heal-Well lighting)the results were striking See figure (3.17).



Increased patient satisfaction



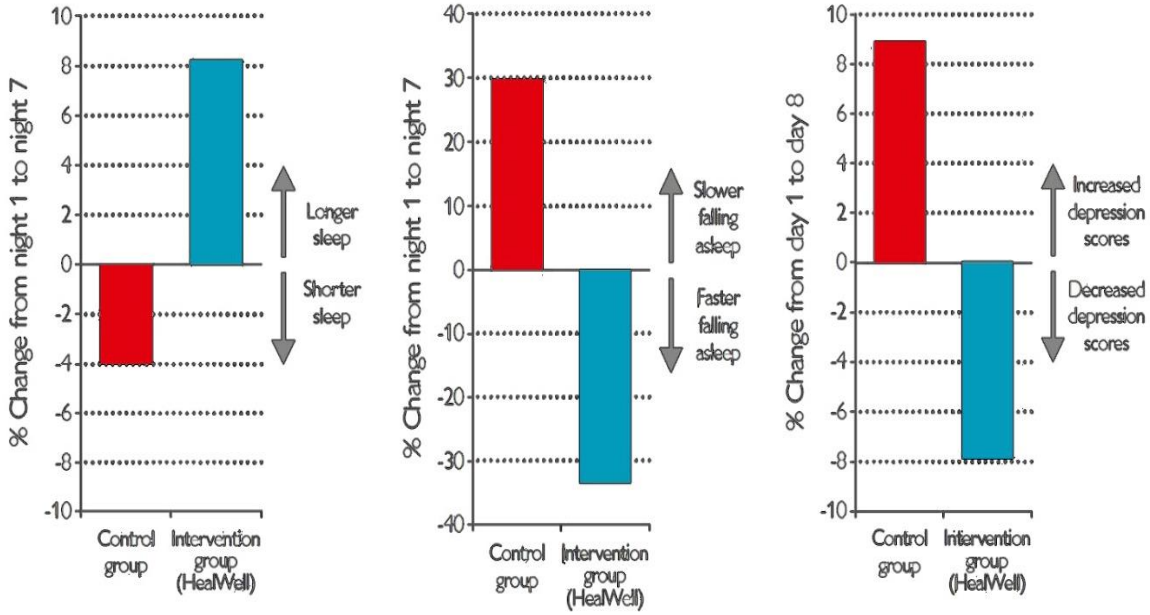
Increased medical staff satisfaction

Figure 3.17: Results show Increased patient and Increased medical staff satisfaction. Source: Philips, 2011

Heal-Well shown to have beneficial effects for patients and staff, thus confirming the positive impact that light can have, as shown in previous studies.

The Heal-Well lighting solution resulted in:

- Improved patient and staff satisfaction
- Longer sleep duration for patients
- Shorter time to fall asleep for patients
- Enhanced mood of patients, as derived from the HADS (Hospital Anxiety and Depression Scale) depression scores. See figure (3.18)



Longer sleeping time **Faster falling asleep** **Enhanced Mood: Decreased HADS depression scores**

Figure 3.18: Results show Longer sleeping time, Faster falling asleep and Enhanced Mood. Source: Philips, 2011.

Heal-Well designed to improve the healing environment, by supporting patient comfort and staff performance with light that adapts to individual needs. Dynamic shades of warm and cool light support patients' biorhythms during the day. Colored light and accents create a pleasant atmosphere in the patient rooms. It also provides high levels of working light for staff, resulting in a complete room lighting system that designed around the needs of patients and staff. Moreover, it uses an intelligent networked control system. It automatically manages a rhythm of dynamic daylight as well as allowing patients and staff to control settings individually. The total lighting system can implemented in your hospital as a turnkey solution. Philips will provide a complete service on project management, lighting design, installation and training for staff. See table (3.10).

Table 3.10: Lighting design in Heal-Well. Source: Philips, 2011			
Ambient light	**Dynamic-natural / examination light**	**Reading & orientation light**	**Empowerment of patient & staff**
			
Atmospheric light • LED based coloured light line in cove opposite to bed **Accent light** • LED spots in ceiling to shine on wall opposite to bed	**Dynamic light modules** • Like natural daylight ceiling modules provide daylight rhythm, with varying light levels and warmer or cooler light according to the time of day **Intelligent light** • Daylight rhythm (special protected lighting curve) • Central control over all lighting • Working light for examinations and emergencies	**Personal reading light** • LED spot, providing dimmable reading light per bed **Orientation light** • Dimmed soft light line in the cove along the wall at night	**Patient remote control** • Choice of atmosphere light (colored cove and spots) • Reading light **Staff working light control** • Wall mounted control per bed For examination/emergency light **Full room control for staff** • Daylight curve • Working light • Orientation light

3.7 Effects of light

Light affects human beings in a variety of ways – visually, (photo-) biologically and psychologically. In healthcare facilities, it can play a key role in promoting the recovery and well-being of patients. As illustrated in figure (3.19). There is a clear correlation between daytime light exposure and the patient has perceived quality of life. The more time spent in daylight, or in daylight-like artificial light, the better the patient's visual performance and comfort, mood, sleep-wake rhythm, concentration, alertness and performance. Clinical parameters such as recovery/length of stay, depression, pain medication and cognitive decline likewise positively influenced by adequate daytime light exposure. There is also strong evidence that light – critical to human functioning – can be extremely beneficial to staff in healthcare settings as well as patients (Schlangen, 2010)

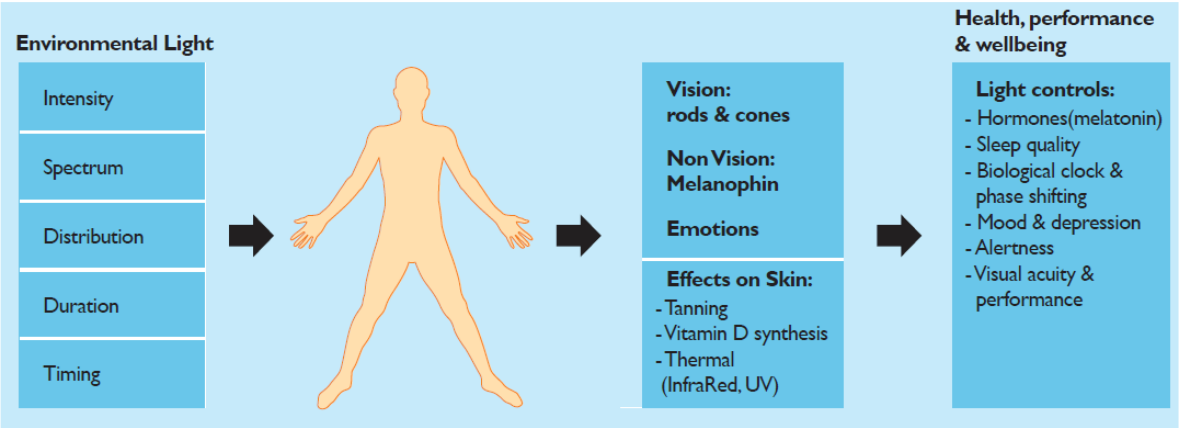


Figure 3.19 Vision, psycho-emotional responses and non-visual or non-image forming effects together affect performance, well-being and health. Source: Schlangen, 2010

Effects of light:

There is three effects of light as show in figure (3.20)

1. Visual effects of light
2. Biological effects of light
3. Psychological effects of light

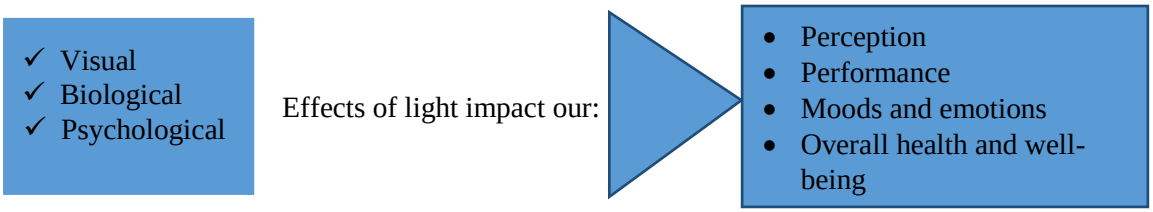


Figure (3.20) Effects of light (visual, biological and psychological). Source: Schlangen, 2010

3.8 Lighting and patient well-being and recovery

The benefits of daylighting and the feeling of openness extend to the staff, visitors, and patients. Many studies indicate that daylighting can lower a facility's operating costs because patients recover faster in daylit recovery centers. The spatial quality from windows also been cited as having a psychotherapeutic quality by providing pastoral views and natural light; therefore, an environment becomes more therapeutic with more spatial quality.

Regulations on windows in hospitals also been made in the United States. These regulations specify that a window should be included in rooms where patients stay for more than 23 hours. Different policies also been created to specify the window area to be included in patient rooms with a bed.

Although there are few recent studies on the effects of natural light in hospitals, these regulations demonstrate the importance of windows in the hospital healing process (Edwards & Torcellini, 2002).

Lighting affects human health and performance by four main mechanisms (Joseph, 2006):

- Enabling performance of visual tasks
- Controlling the body's circadian system
- Affecting mood and perception
- Facilitating direct absorption for critical chemical reactions within the body

3.8.1 Enabling performance of visual tasks

Light's most obvious effect on humans is in enabling vision and the performance of visual task. Many Studies demonstrate that the nature of the task determines the performance level that achieved, and that the need for light increases as a function of age due to reduced transmittance of aging eye lenses. The need for light increases as a function of age. With increasing age the eye lens transmittance changes. The lens becomes more scattering and yellow (Schlangen, 2010).

In general, visual acuity increases with increasing illuminance. This is especially relevant for the more aged part of the population. Elderly people (70-80 years) need about ten times more light to achieve the same visual performance as compared to middle-aged people (45-55 years) As illustrated in figure (3.21)(Schlangen, 2010).

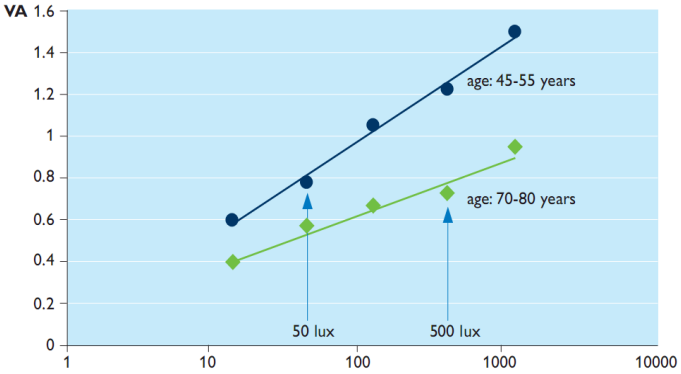


Figure 3.21: visual acuity increases with increasing illuminance. Source: Schlangen, 2010.

a. Reducing errors

The work environment for nurses and physicians in hospitals is stressful. They are required to perform a range of complex tasks. Inadequate lighting and a chaotic environment are likely to compound the burden of stress and lead to errors (Joseph, 2006).

One study examined the effect of different illumination levels on pharmacists' prescription-dispensing error rate. They found that error rates reduced when work-surface light levels were relatively high. In this study, three different illumination levels evaluated (450 lux; 1,100 lux; 1,500 lux). Medication-dispensing error rates were significantly lower (2.6%) at an illumination level of 1,500 lux (highest level), compared to an error rate of 3.8% at 450 lux. This is consistent with findings from other settings that show that task performance improves with increased light levels (Boyce , Hunter, & Howlett , 2003).

3.8.2 Controlling the body's circadian system

By controlling the body's circadian system, light – both natural and artificial – influences many health outcomes, e.g. by reducing depression, improving sleep and circadian rest-activity rhythm, easing pain and shortening the stay in the healthcare (Philips, 2011).

An internal clock that synchronized to light–dark cycles generates the circadian rhythm. It depends on sunlight, which indicates when to become active and when to sleep as illustrated in figure (3.22) (Riegens lighting, 2013)

Three components of circadian rhythm are (Harrell, FAIA, FACHA, & LEED AP, 2012):

- Internal oscillator - hypothalamus
- External oscillator – light/dark
- Melatonin – determines energy levels

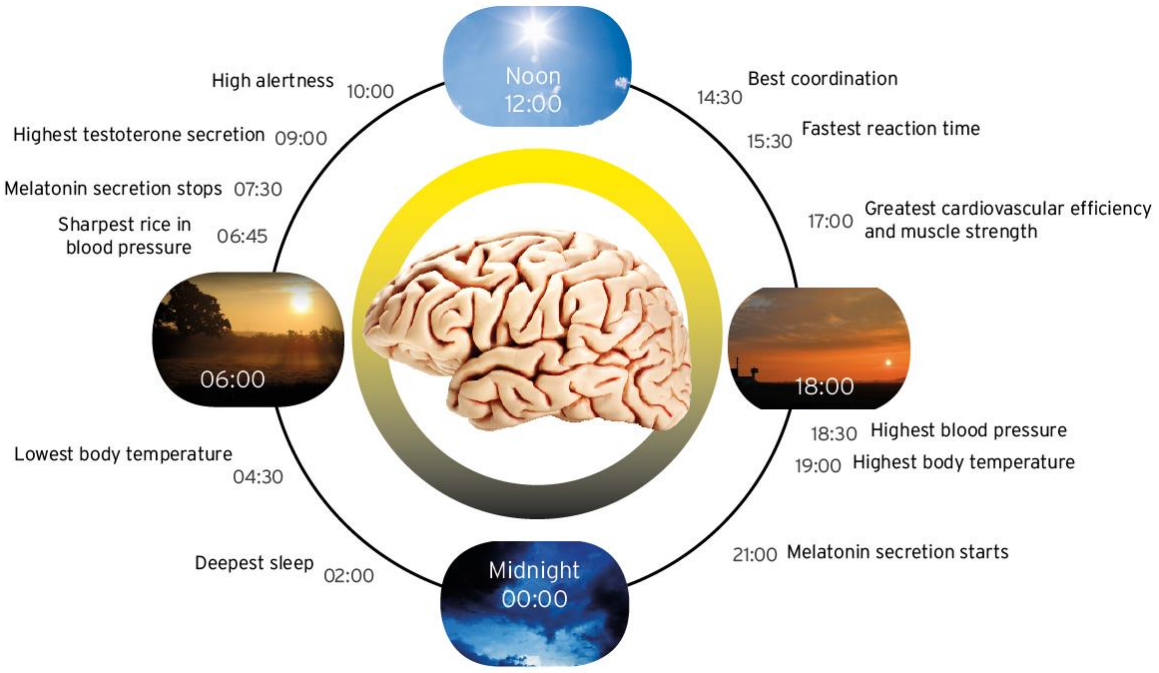


Figure 3.22: Controlling the body's circadian system. Source: Riegens lighting, 2013

The effect of light on human biological clock is important as it influences many aspects of our physical and emotional well-being. This biological clock regulated by light and darkness, by the daily cycles of night and day and the time we spend asleep and awake.

In the morning, when the sun comes up and light levels increase, we wake up and become active and alert. In the evening, when the sun goes down, we unwind, relax and prepare for sleep. Human body's hormone levels rise and fall with these light cycles. Cortisol production increases with morning light and decreases throughout the course of the day.

Melatonin levels increase as darkness sets in and decrease as morning approaches. See figure (3.23).

In our modern society, we spend much of our time indoors at home, in a school, office, shop or hospital. Those who have to stay indoors for significant parts of their time, like hospital patients, can be particularly at risk of getting insufficient light during the day to set their biological clock properly(Philips, 2011).

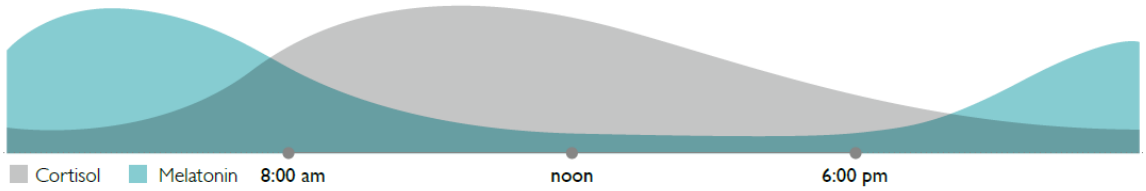


Figure 3.23: Cortisol and Melatonin levels during the day. Source: Philips, 2011

Table 3.11:Cortisol and Melatonin levels during light exposure. Source:Philips, 2011

Morning	Evening	Nocturnal
• increases cortisol levels, reducing morning drowsiness • advances the endogenous circadian rhythm: sleep timing is advanced and it becomes easier to get up (earlier) the next day	• delays the endogenous circadian rhythm: sleep timing is delayed and it becomes easier to stay up (later) and rise later the next day	• reduces melatonin levels • increases alertness

a. Strength of circadian rhythm is associated with quality of life, age and clinical outcome

Increasing age is associated with progressive deterioration in the structure, 24-hour distribution and quality of sleep. In general, the endogenous circadian rhythm declines over age, as indicated by the levels of both melatonin and cortisol that decline with age. See figure (3.24).

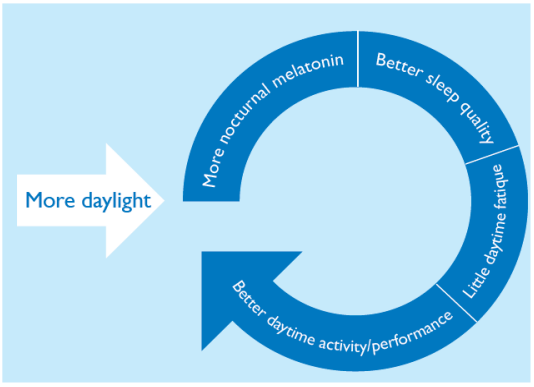


Figure3.24: showing how daytime light exposure improves sleep and daytime activity levels. Source: Schlangen, 2010

Moreover, elderly people like to go to bed earlier compared to younger people. The nocturnal level of melatonin in elderly people can boosted by daytime illumination, thus strengthening the endogenous circadian rhythm.

Elderly people need 3 to 5 times more light for the same visual performance compared to younger people. In many cases, elderly people live in conditions with insufficient illumination, forcing them to stop activities due to inadequate visual performance (Schlangen, 2010).

b. Improving quality of life for the demented: reducing nocturnal restlessness, depression and cognitive decline

Among the elderly, chronic sleep disturbance impairs quality of later life, inhibits recovery and rehabilitation following illness, and increases the risk of falls and depression.

As the population gets older, the number of people suffering from memory impairment increases. Memory impairment is the most obvious symptom of dementia, which eventually precludes leading lead a normal life. It often accompanied by depression and agitation (restlessness) at night. Dementia may be associated with impairment of the biological clock. As they age, people spend less time outdoors, so their biological clock receives less light stimulation. Elderly people with dementia living in a nursing home experience a reduction in exposure to daylight of 2000 Luxor above from a few hours per day to just one hour, or even as little as 1.6 minutes.

More studies that are recent also indicate that the development of Alzheimer's disease can slowed down by means of light therapy. This treatment resulted in reduced cognitive decline (5%), ameliorated depressive symptoms (19%) and attenuated the increase in functional limitations (53%)(Schlangen, 2010).

3.8.3 Affecting our mood

Daylight is never constant. It changes throughout the day and over the seasons, affecting our emotions, moods, perception and performance. In the absence of incident daylight, artificial lighting with daylight-like dynamics can used to create a natural lighting ambience that has a positive stimulating effect on patients.

a. Reducing depression

Research has shown that an individual's psychological state can affect their risk of mortality following physical illness. In one study, immediately following a life-threatening illness, approximately 34% of the patients were depressed, but the depressed group did not have a more severe physical illness. However, the depressed patients had a significantly poorer outcome over the 28 days following admission, with 47% of the depressed patients dying or having life-threatening complications, as opposed to 10% of the non-depressed group. It has shown that having enough light during the day, particularly during winter, has a beneficial effect on mood and general quality of life (Joseph, 2006).

In some countries, light therapy is the first choice for the treatment of SAD. Artificial light treatments usually range between 2,500 lux and 10,000 lux for a few hours per day to 30 minutes respectively. Often a treatment period of one or two weeks considered appropriate (Schlangen, 2010).

b. Decreasing length of stay

Light has shown to have an impact on length of stay among depressed patients. Other studies suggest that exposure to light may linked to length of stay among clinically non-depressed patients as well. A retrospective study of myocardial infarction patients in a cardiac intensive-care unit treated in either sunny rooms or dull rooms found that female patients stayed a shorter time in sunny rooms (2.3 days in sunny rooms, 3.3 days in dull rooms). Mortality in both sexes was consistently higher in dull rooms (39/335 dull, 21/293 sunny). Another study found that Veterans Health Administration medical centers located in warmer and drier climates had shorter length of stay of patients. Hospitals in colder climates had longest lengths of stay in winter and fall.(Joseph, 2006)

In yet another study, 23 surgical patients assigned to rooms with windows looking out on a natural scene had shorter postoperative hospital stays, received fewer negative evaluative comments in nurses' notes, and took fewer potent analgesics than 23 matched patients in similar rooms with windows facing a brick building wall(Schlangen, 2010).

c. Easing pain

A recent randomized prospective study assessed whether the amount of sunlight in a hospital room modifies a patient's psychosocial health, quantity of analgesic medication used, and pain medication cost. Patients undergoing elective cervical and lumbar spinal surgeries admitted to the bright or the dim side of the same hospital unit postoperatively (Joseph, 2006).

The outcomes measured included the standard morphine equivalent of all opioid medication used after the operation by patients and their subsequent pharmacy cost. As illustrated in figure (3.25), patients staying on the bright side of the hospital unit exposed

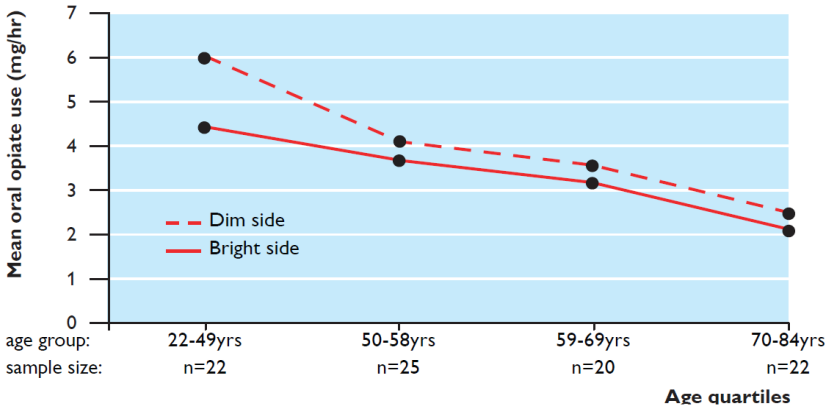


Figure 3.25: show how lighting easing pain in a study. Source: Schlangen, 2010

to, on average, 46% higher-intensity sunlight. This study noted that patients exposed to a higher intensity of sunlight experienced less perceived stress, marginally less pain, took 22% less analgesic medication per hour, and had 21% less pain medication costs(Schlangen, 2010).

Better outcomes for patients on the unit's bright side

- Less perceived stress
- Less pain
- Took 22% less analgesic medication per hour
- Incurred 21% less medication costs

3.8.4 Direct absorption for critical chemical reactions in the body

Light radiation is absorbed directly by the body through the skin, and this stimulates chemical reactions in the blood and other tissues. There are two implications of this on health outcomes in healthcare settings (Joseph, 2006).

- supports Vitamin D metabolism and
- Prevents jaundice

3.8.5 Staff well-being – caring for the career

There is strong evidence that light is critical to human functions and can be extremely beneficial to staff in healthcare settings as well as patients. Hospitals are high-intensity 24/7 working environments. Staff must be able, on the one hand, to communicate effectively with patients, and on the other to concentrate on demanding tasks and make quick decisions under pressure at any time of the day or night. In this respect, their sense of well-being and motivation play a significant part in how a hospital performs and as such have an influence on patient recovery processes (Schlangen, 2010).

a. Light affecting staff performance

In hospital spaces with no direct natural light, dynamic lighting solutions can applied to make staff feel connected to the outside world. These solutions utilize certain dynamic characteristics of daylight to enhance the well-being, motivation and performance of those working indoors by giving them control over their lighting and creating a stimulating lighting ambience (changes in the level and tone of white light) that follows the rhythm of human activity. This makes it possible to create 'natural' lighting that helps healthcare professionals perform even more effectively, for instance by boosting alertness and concentration levels, e.g. on the night shift. Independent research has corroborated that daytime blue-enriched white light in the workplace improves self-reported alertness, performance and nocturnal sleep quality (Schlangen, 2010).

3.9 Conclusion

This chapter addressed the issue of lighting in healthcare buildings and its relation with well-being. It focused on the lighting in patient room in order to enhance patients' well-being, which includes visual, biological and psychological effects. The chapter outlined the quantity and quality lighting design consideration in patients' room. Hence, this chapter highlighted the impact of health care lighting on visual tasks, controlling the body's circadian system, affecting mood and facilitating direct absorption for critical chemical reactions within the body. It also show the new lighting solution to promote well-being in patients' room.

The chapter concluded that the key quality lighting design consideration for healthcare must achieve visual emotional and biological requirements. Moreover, Light trespass during sleep hours must be controlled to minimize exposure that can alter circadian rhythms. Also, Lighting have an effect on human well-being by enabling performance of visual tasks, controlling the body's circadian system which is important as it influences many aspects of our physical and emotional well-being, affecting mood and perception, facilitating direct absorption for critical chemical reactions within the body. Many studies investigate and conclude that, the need of light increase as a function of age, visual acuity increase with increasing illuminance, task performance improves with increased light levels, error rates reduce when work-surface light levels are relatively high. . In addition, the body's hormone levels rise and fall with light cycles by a day. Cortisol production increases with morning light and decreases throughout the course of the day. Melatonin levels increase as darkness sets in and decrease as morning approaches.

The chapter clarified some previous studies, which dealt with similar aspects. It is concluded that the healthcare, which located in warmer and drier climates, had shorter length of stay of patients. While hospitals in colder climates had longest lengths of stay in winter and fall. Moreover, the patients which, exposed to a higher intensity of sunlight experience less perceived stress, marginally less pain, took 22% less analgesic medication per hour, and had 21% less pain medication costs. In addition, dynamic lighting solutions can applied in hospital spaces with no direct natural light, to make staff feel connected to the outside world that, enhance the well-being, motivation and performance by giving them control over their lighting and creating a stimulating lighting ambience (changes in the level and tone of white light) that follows the rhythm of human activity.

Chapter 4

Methodology of the study

4.1 Introduction

This chapter contains the procedures followed throughout the study. It introduces a complete description of the methodology of the study, place of study, the community, the sample, the instrumentation and measurement tool that were used to measure lighting intensity in the studied patients' rooms. Moreover, it introduces the statistical treatment for the study findings. The aim of this chapter is to evaluate the existing lighting situation in surgery, internal medicine and heart care department in Al-shifa Hospital.

4.2 The Methodology of the study

Methodology used in the study was applied through POE tool, which used mixed method that depend on quantitative and qualitative data. Questionnaire was used to collect qualitative data and analyze it, during the application of the questionnaire measurements of lighting intensity inside patients' room were taken by using iPad app called luxmeter, then the measurements were interpretation and analysis to get the desired results from the study. See figure (4.1)

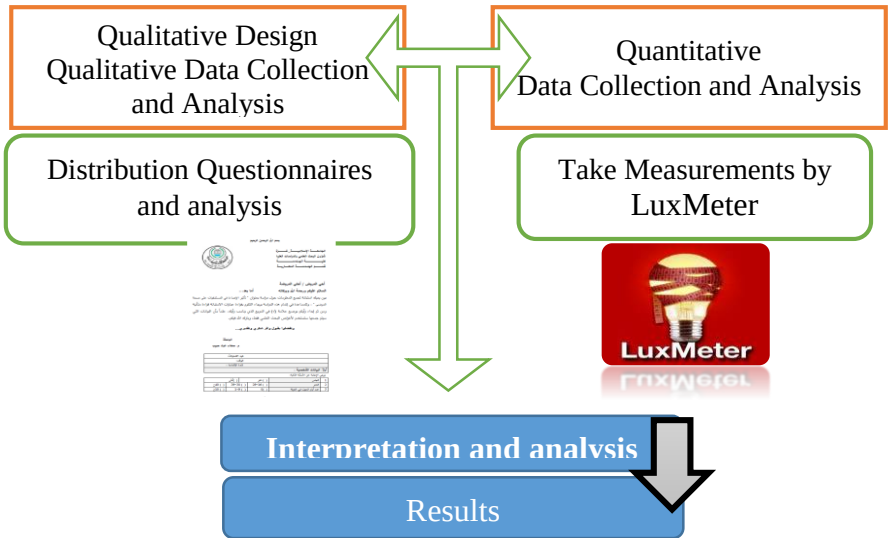


Figure 4.1: The Methodology of the study

The Questionnaire was used to collect qualitative data by gathering the feedback from patients' experiences about lighting in their rooms. And used quantitative measures including lighting intensity, as a validation tool and key metric in building evaluation and compared with the occupant feedback to provide a better understanding of values. The questionnaire was used to determine the satisfaction of respondents at each light environment and investigate the effect of natural and artificial lighting on patients' well-being in surgery, internal medicine and heart care departments at Al-Shifa Hospital. The questionnaire targeted inpatients (male and female). In addition, lighting intensity was measured by iPad application (LuxMeter), which use the camera of iPhone or iPad to measure the light intensity. The data was analyzed by computer software Statistical Package for the Social Sciences (SPSS). Measurements were used as validation tool.

Study was based on two main instruments:

- **Questionnaire**

The main objective of this thesis is to determine the current lighting design in patients' rooms in surgery, internal medicine and heart care departments at Al-Shifa Hospital and assess the effect of lighting in health care on patients' well-being, which included visual, biological and psychological effects. The questionnaire in order to achieve the goals of this research it was used as a comparative analysis methodology tool. The questionnaire was analyzed to propose recommendations related to this issue.

A Likert-scale was used as the main tool to gather data about professional development obstacles. A Likert scale gives a range of responses to a question (Cohen, Manion, and Morrison, 2010). Here, the scale consists of five choices: strongly agree, agree, neutral, disagree, and strongly disagree. Each choice has a code like the following table (4.1):

Table 4.1:A Likert-scale. Source: Cohen, Manion, and Morrison, 2010

Question	strongly agree	agree	neutral	disagree	strongly disagree
Scale	5	4	3	2	1

When a respondent chooses "strongly disagree", the question is calculated as one point, and when a respondent chooses "strongly agree", the question is calculated as five points. Therefore, the highest sum a question can get is when all participants choose "strongly agree". For example, the first question in the questionnaire is (**Level of lighting is enough to perform vision**), the total number of the questionnaire respondents were (54). As a result, the highest sum which this question can get is the outcome of fifty four times five that is (270). The lowest sum the same question can get is when all participants choose "strongly disagree". Then, the sum is the outcome of fifty four times one that is (54).

- **Measurements tool by LuxMeter**

To collect quantitative data there is a mobile application (LuxMeter). See figure (4.2). This app allows users to use the camera of iPhone or iPad to measure the light intensity (LuxMeter, 2012).The measurements were taken in the middle of patient bed. As seen in figure (4.3). In three days (Thursday, Friday, and Saturday) form 23 to 25 of April, 2015 at (11 am to 2 pm).

Figure 4.2 LuxMeterapp. Source: LuxMeter, 2012

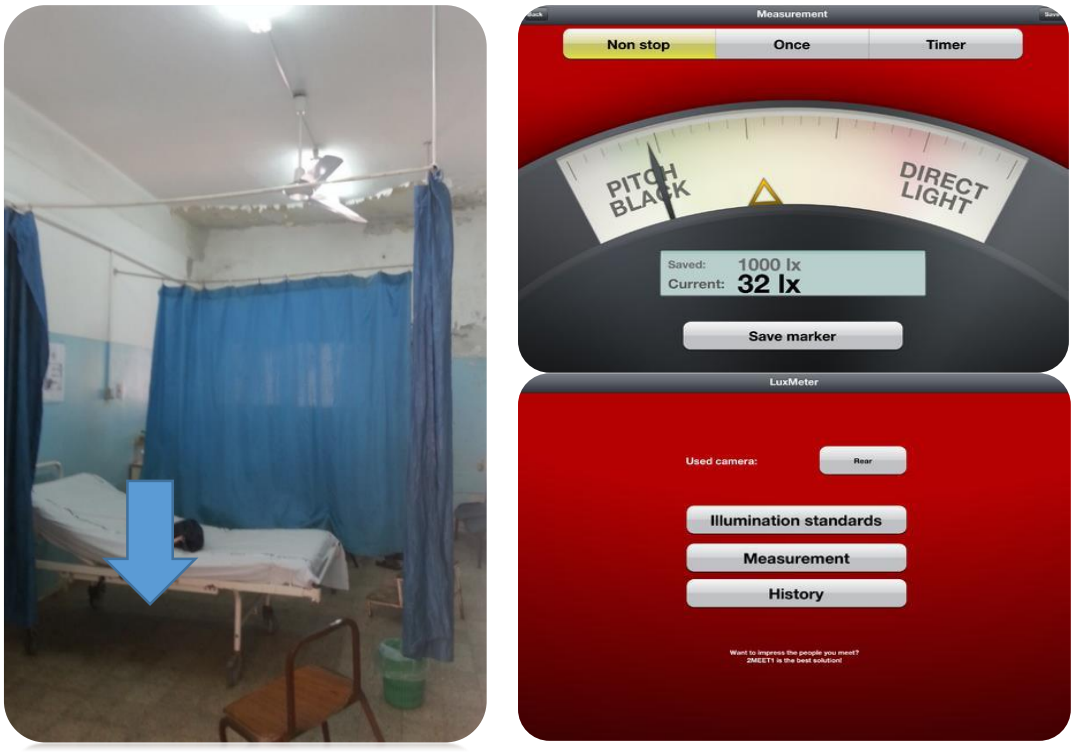


Figure 4.3luxMeter app and the place of mesurments.
Source: The reseacher&LuxMeter, 2012

4.3 Place of study

The qustionannire was applied in Al-shifaHospital at middle of Gaza, which is considered the biggest medical complex in Gaza strip and a govermental hosptial.

It is includes multiple departments such as surgry, internal medicine, maternity section, and it is built on 42.000 squre meter(Palestinian Ministry of Health, 2012).

33 qustionannire were distribured on surgery, internal medicine, heartcare for men and women departments to know the current situation of lighting used in the hospital and to know its effects on patients' health (visual, biological and psychological), figure (4.4) shows hospital buildings. The qustionannire was applied in surgery building number (8) and internal medicine and heartcare number (3).

Figure 4.4Site plan for Al-Shifa Hospital source: Engineering office, Al-Shifa Hospital

4.3.1 Surgery Building

Surgery building consists of 6 floors and the qustionannire was applied in the third and the fourth floor, men and women patients' rooms, Figure (4.5) shows that the orientation of the patients' rooms is east to west and the ratio of opennigs to wall (35%).

Figure 4.5: Surgery Building. Source: Palestinian Ministry of Health, 2012

- **Patients' rooms of Surgery department**

Each room consists of 3 beds for patients seperated by curtains. It depends on fluorescent artificial lighting and natural lighting, controlling of lighting by two keys, one of them controlsluminaire above the bed and the other for lighting corridor and it is manually controlled, figure (4.6) shows distribution of luminaire inside rooms. And figure (4.7) shows patients' rooms of surgery department.

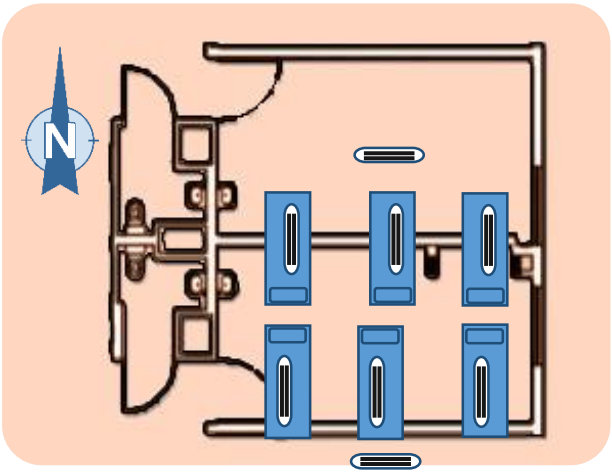


Figure 4.6: Distribution of luminaire inside rooms source: The researcher

Figure 4.7Patient' rooms of surgery department source: The researcher

4.3.2 Internal MedicineBuilding

Both heartcare and internal medicine consit of one floor and the qustionannire was distributed in men and women patients rooms. The orientation of patients' rooms in internal medicine is north to south, and patients' rooms of the heartcare is east to west. The ratio of openings to wall in internal medicine is (24%). In heartcare department the ratio of openings to wall is (15%).

- **Patients' rooms of the internal medicine department**

Each internal medicineroom consist of 5 beds for patients, seperated by curtains,and there are isolation for rooms which contains 1 bed. It depends on artifical fluorescent lighting and natural ligting, and it is controlled by one switch for all of lighting sources in the room. Figure (4.8) shows the distribution of luminaire inside the room. And figure (4.9) shows patients' rooms of internal medicinedepartment.

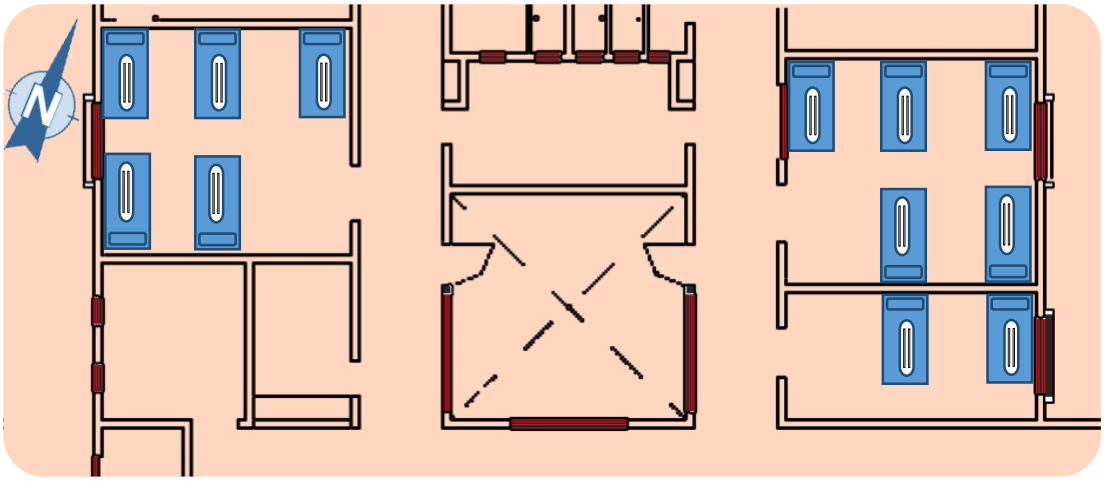


Figure 4.8: Plan shows the distribution of luminaire inside rooms source: The researcher

Figure 4.9:Patients' rooms of internal medicine department.source: The researcher

- **Patients rooms of heartcare department.**

Each room consists of (8) beds for paiteins seperated by curtains, and it depedns on artifial ligting (fluorescent) and natural lighting, contrlloing of these luminaire by many switches, every bed have switch, and there are other keys for middle corridor. Figure (4.10) shows distribution of luminaire inside rooms.And figure (4.11) shows patients' rooms of heartcare department.

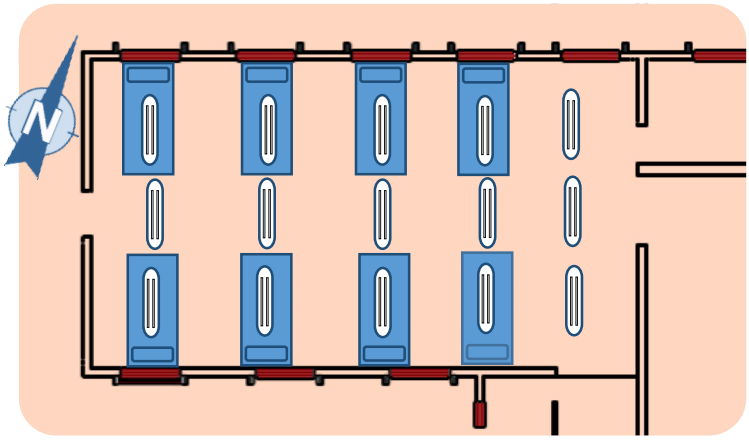


Figure 4.10: Plan shows the distribution of luminaire inside rooms

source: The researcher

Figure 4.11:patients' rooms of heartcare department. source: The researcher

4.3.3Luminaire proporties

The type of luminaire used in all patient rooms in Alshifaa hospital (surgey, internal medicine, heartcare) is fluorescent (FL40T9D/38) as illustrated in figure (4.12), and table (4.2) shows the properties of the used lighting.

Figure 4.12: Tubular fluorescent lamp. Source: (ECA), 2011

Table 4.2:Properties of used lighting	
Fluorescent Lamp	
Type	FL40T9D/38
CCT color temperature	6.500K
Watt	38
Intensity	2700
Ra	74
Color	daylight
Daylight fluorescents have a CCT of 5000 K to 6500 K, which is bluish-white.	

4.4 The Study Community

The community of the study consisted of all the Inpatients in Surgery, Internal medicine and Heart Care departments in Al-Shifa Hospital. Who were at the hospital during applying the questionnaire and taking measurements (23-25 April), the community of the study was (66) patients (Computer Center at Al-Shifa Hospital, 2015). The questionnaire was distributed in 21 patient room (10 room from surgery department, 10 room from internal medicine department and a room from heart care department).

Table (4.3) shows distribution of study community according to department.

Table 4.3:distribution of study community according to department. Source: Computer Center at Al-Shifa Hospital, 2015	
Department	Patient Number
Surgery	32
Internal medicine	28
Heart Care	6
Total	**66**

4.4.1 The Sample of the Study

The sample of the study consisted of 50% of the community of the study which equals(33) Inpatients were stratified and randomly chosen from a purposive sample from Al-shifa Hospital in the Gaza Strip, the questionnaire was distributed on 33 patients, 30 of them filled it, which is 90.9%

Tables (4.4), (4.5), (4.6), (4.7) and (4.8) and figure (4.13), (4.14), (4.15), (4.16) and (4.17) shows the distribution of the sample according to gender, age, Stay period, Building Typeand Orientation.

Table 4.4: The distribution of the sample according to gender		
Gender	No.	%
Male	16	53.33
Female	14	46.67
Total	30	100.00

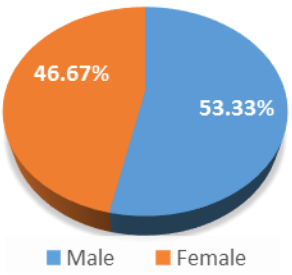


Figure 4.13 The distribution of the sample according to gender

Table 4.5: The distribution of the sample according to age		
Age	No.	%
16-29	11	36.67
30-40	5	16.67
More than 40	14	46.67
Total	30	100.00

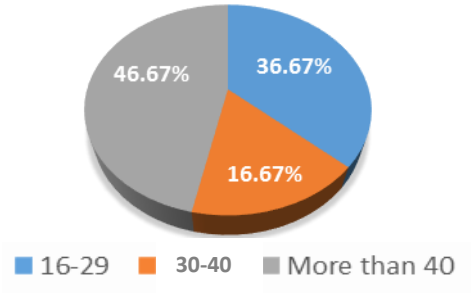


Figure 4.14 The distribution of the sample according to age

Table 4.6: The distribution of the sample according to Stay period in room		
Number of days of sleeping in the room	No.	%
1-10	22	73.33
more than 10	8	26.67
Total	30	100.00

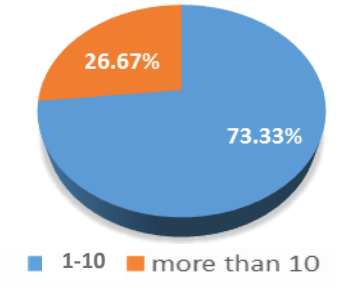


Figure 4.15The distribution of the sample according to stay period in room

Table 4.7: The distribution of the sample according to Building Type		
Department	No.	%
Surgery	15	50.00
Internal medicine	9	30.00
Heart Care	6	20.00
Total	30	100.00

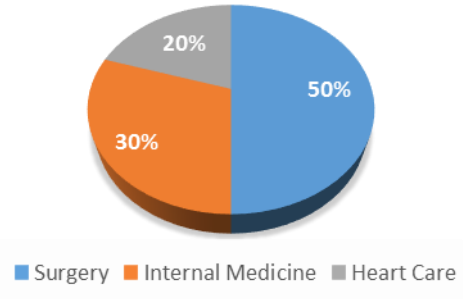


Figure 4.16 The distribution of the sample according to Building Type

Table 4.8: The distribution of the sample according to Orientation		
Orientation	No.	%
East	10	33.33
West	9	30.00
North	2	6.67
South	9	30.00
Total	30	100.00

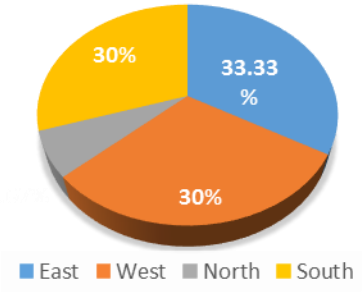


Figure 4.17The distribution of the sample according to Orientation

4.5 The procedure of the Study

The qualitative data that the researcher used in the study was collected according to following steps:

- Review the related objectives and previous studies related to the study problem.
- Determination of the main fields that the questionnaire includes.
- Expressing paragraphs that each field contain
- Preparation of the questionnaire at its initial version.
- Presenting questionnaire on the supervisor to examine if itis fitting for collection data.
- Modify questionnaire according to the supervisor comment.
- Presenting the questionnaire on 5 specialists. All of whom work at the Islamic university and the university of Palestine.
- After finishing the modification stage, some paragraphs were revised, deleted, and paraphrased. The Number of questionnaire paragraphs after final modification is 5 that distributed on 5 fields. As seen in table (4.9).
- Each paragraph was given weight according to five choices scale: strongly agree, agree, neutral, disagree, and strongly disagree. Each choice has a code like the following: 1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5= strongly agree.
- Obtaining a paper, which facilitates the researchers' task from the Islamic university and given to (Directorate General of Human Resources Development) to have the approval to implement the questionnaire in Al-shifa hospital: surgery, internal medicine and heart care departments. See appendix 1
- The questionnaire was distributed on all of sample members to collect necessary data for study.

Table 4.9: Number of questions in each field	
Field	Number of questions
Effects of lighting level on patient s' well-being (Visual, Biological, Psychological)	**16**
Effects of color and temperature of lighting on the patients' well-being	**15**
Effects of lighting on patient s' sleeping	**4**
Effects of integration between natural light and artificial light on patient s' well-being (Visual, Biological, Psychological).	**8**
Suggested solution	**11**
Total	**54**

The Questionnaire was divided into two parts: The first part was designed to collect information about the sample's gender, age, Stay period in room, Intensity of illumination, Building Type. And Orientation. The second part was allocated for the five different fields. See (appendix 2). The value of each field is calculated out of the summation of the value of all the questions in that field. A cover letter was attached to the questionnaire in order to explain the purpose of the study and encourage honest participation.

4.5.1 Validity of the questionnaire

A valid questionnaire measures what it is designed to measure. The researcher used the referee validity and the internal consistency validity to ensure the questionnaire validity.

- **The Referee Validity**

The questionnaire was refereed by a panel of referees. Seetable (4.10). Some are university professors. The referees were asked to check the clarity and relevance of the questionnaire questions. Some questions were deleted, and some others were modified according to the referees' comments.

Table 4.10: The specialists arbitrated the questionnaire	
Name	**Specialization**
Dr. Farid El Qeeq	Professor, Department of Architecture, IUG
Dr. Ahmed S. Muhaisen	Associate Professor, Department of Architecture, IUG
Dr. Omar Asfour	Associate Professor, Department of Architecture, IUG
Dr. SuhairAmmar	Assistant Professor, Department of Architecture, IUG
Dr. HusameddinDawoud	Assistant Professor, Department of Architecture, UP

- **Internal consistency**

Internal consistency indicates the correlation of the degree of each question with the total of the questionnaire. The internal consistency coefficient was computed using Pearson formula (McMillan, 2004) notes that. The following tables(4.11), (4.12), (4.13), (4.14) and (4.15) show the data analysis of the correlation coefficient of each question with the field it belongs in order to compare it with the whole degree of the questionnaire

Table 4.11: Pearson Correlation coefficient for every question from the first field with the total degree of this field

Question	**Pearson Correlation**	**Sig. level**
Level of lighting intensity is enough to perform vision.	0.817	sig. at 0.01
Level of lighting intensity is enough to perform reading.	0.721	sig. at 0.01
Level of lighting intensity is enough to perform movement.	0.584	sig. at 0.01
Level of lighting intensity is enough to perform eating	0.480	sig. at 0.01
Number of light units is enough	0.591	sig. at 0.01
Shapes of lighting units are beautiful and attractive.	0.781	sig. at 0.01
Variety of light units is good	0.614	sig. at 0.01
There are undesirable reflected lights from some surfaces in the room	0.431	sig. at 0.05
The lights cause eye sensitivity	0.619	sig. at 0.01
The lights cause eye stress.	0.642	sig. at 0.01
lighting Intensity level makes you feel comfortable	0.610	sig. at 0.01
lighting Intensity level makes you feel active and vital	0.525	sig. at 0.01
lighting Intensity level makes you feel drowsiness and laziness	0.362	sig. at 0.05
lighting Intensity level makes you feel nervous	0.570	sig. at 0.01
Level of lighting intensity is sometimes not enough	0.631	sig. at 0.01
You can control lighting intensity in the room	0.390	sig. at 0.01

Table 4.12: Pearson Correlation coefficient for every question from the second field with the total degree of this field

Question	**Pearson Correlation**	**Sig. level**
Color of lighting is appropriate to see things clearly	0.544	sig. at 0.01
Color of lighting is appropriate to see colors as they really are.	0.607	sig. at 0.01
Color and temperature of lighting makes you feel active and vital	0.689	sig. at 0.01

Color and temperature of lighting makes you feel calm and relaxed	0.767	sig. at 0.01
Color and temperature of lighting makes you feel awake.	0.736	sig. at 0.01
Color and temperature of lighting makes you feel pleased.	0.626	sig. at 0.01
Color and temperature of lighting makes you feel upset and worried	0.507	sig. at 0.01
Lights' color fitswith the colors of the room	0.443	sig. at 0.05
Colors of lights makes you feel comfortable	0.780	sig. at 0.01
Feeling of the beauty of the place by colors of lights.	0.652	sig. at 0.01
Feeling of the formality of the place by colors of lights	0.570	sig. at 0.01
Feeling of the safety of place by colors of lights.	0.397	sig. at 0.05
Feeling of warmth of place by colors of lights	0.733	sig. at 0.01
You can control colors of lighting in the room	0.685	sig. at 0.01
Colors of lighting control in the room makes you feel comfortable	0.606	sig. at 0.01

Table 4.13: Pearson Correlation coefficient for every question from the third field with the total degree of this field

Question	**Pearson Correlation**	**Sig. level**
I can sleep when the current lighting on	0.891	sig. at 0.01
I feel more comfortable when lights are off	0.743	sig. at 0.01
I feel comfortable in existing lighting at sleeping time	0.826	sig. at 0.01
I can control color of lighting at sleeping time	0.795	sig. at 0.01

Table 4.14: Pearson Correlation coefficient for every question from the four field with the total degree of this field

Question	**Pearson Correlation**	**Sig. level**
The level of lighting intensity of artificial lights changes appropriately with natural lights during day	0.732	sig. at 0.01
Color of artificial light is integrated with colors of natural lighting during day	0.774	sig. at 0.01
Integration of natural lighting and artificial lighting makes you feel active and vital	0.596	sig. at 0.01
Integration of natural lighting and artificial lighting makes you feel comfortable	0.566	sig. at 0.01
Integration of natural lighting and artificial lighting makes you feel calm and relaxed	0.730	sig. at 0.01

Integration of natural lighting and artificial lighting makes you feel the beauty of the place	0.665	sig. at 0.01
Integration of natural lighting and artificial lighting makes you feel the safety of the place	0.672	sig. at 0.01
Integration of natural lighting and artificial lighting makes you feel the formality of the place	0.486	sig. at 0.01

Table 4.15: Pearson Correlation coefficient for every question from the five field with the total degree of this field

Question	**Pearson Correlation**	**Sig. level**
I prefer to change light intensity automatically during the day	0.529	sig. at 0.01
I prefer variety of lighting color in the room	0.594	sig. at 0.01
I prefer to control color of lighting in the room	0.725	sig. at 0.01
I prefer to change color of lights automatically during day	0.709	sig. at 0.01
I prefer to turn the lights off at sleeping time	0.760	sig. at 0.01
I prefer to change color of lighting at sleeping time	0.702	sig. at 0.01
I prefer variety of lighting distribution in the room	0.573	sig. at 0.01
I prefer variety in lighting units' shapes in the room	0.422	sig. at 0.05
I prefer integration between natural and artificial lighting	0.679	sig. at 0.01
I prefer to control natural and artificial lighting	0.530	sig. at 0.01
I prefer artificial lighting to natural lighting	0.708	sig. at 0.01
r Table value at of (28) and sig. level (0.05) = 0.361 r Table value at of (28) and sig. level (0.01) = 0.463		

From tables (4.11), (4.12), (4.13), (4.14) and (4.15) it can be inferred that there is a relation between all fields at sig. level (0.01, 0.05) that means the value of these questions were suitable and highly consistent and valid for conducting this study.

4.5.2Reliability

The test is reliable when it gives the same results if it is reapplied in the same conditions (Al Agha & Al Ostaz, 2004). The researcher used the sample of the study to calculate the reliability of the questionnaire -because there is no an availability of pilot study- which was measured by Alpha Cronbck and split-half methods.

The researcher calculated the correlation between the first and the second half of each field of the questionnaire and the whole of the questionnaire. Then, the researcher used Gutman Formula to modify the length of the questionnaire to find out the reliability coefficient as shown in table (4.16).

Table 4.16: Correlation coefficient between the two halves of each field before modification and the reliability after modification			
Field	**No. of questions**	**Correlation between two parts**	**Reliability after modifying**
Effects of lighting level on patients' well-being (Visual, Biological and Psychological)	16	0.644	0.784
Effects of color and of lighting on the patients' well-being	*15	0.682	0.683
Effects of lighting on patients' sleeping	4	0.791	0.883
Effects of integration between natural light and artificial light on patients' well-being (Visual, Biological and Psychological).	8	0.700	0.824
suggested solution	*11	0.695	0.712
*** used Gutman coefficient for unequal halves**			

Table (4.16) shows that the reliability coefficient by using split- half after modification more than (0.683) and this indicates that the questionnaire is reliable and the research is satisfied to apply it on the sample of the study.

A total sample of (30) patient participated in testing the reliability of the questionnaire, **Alpha formula** was used to determine the reliability of the questionnaire as shown in table (4.17).

Table 4.17: Alpha Correlation Coefficient of the questionnaire Reliability		
Field	**Number of Questions**	**Alpha Cronbach**
Effects of lighting level on patients' well-being (Visual, Biological and Psychological)	16	0.827
Effects of color and of lighting on the patients' well-being	15	0.890
Effects of lighting on patients' sleeping	4	0.831
Effects of integration between natural light and artificial light on patients' well-being (Visual, Biological and Psychological).	8	0.804
Suggested solution	11	0.845

The results of table (13) showed that the ranges of reliability of the five fields were above (0.804). These results indicate that the questionnaire was suitable for conducting such study. The reliability of the questionnaire was measured by Alpha Cronback and the split-half methods.

4.6 Statistical treatments used for the questionnaire

The data were collected and computed using (SPSS) Statistical Package for Social Science.

1. The data was collected and computed using Pearson correlation, Cronbach Alpha, Gutman coefficient for unequal halves and Split-half techniques to confirm the validity and reliability of the questionnaire.

2. Means and percentages were used to determine the **Effect of lighting on patients' wellbeing**

3Mann Whitney Test was used to measure the statistical differences in means according to patient genders.

4. Kruskal-Wallis test was used to measure the statistical differences in means between the patient age, Building, Orientation, Stay period in room

5. Scheffe Post Hoc test matrix was used to identify the direction of differences among the fields.

4.7 Conclusion

This chapter dealt with the methodology of the study, which used the POE tool to carry out the study. In addition, it showplace of study, the community, the sample, the instrumentation and measurement tool that were used to measure lighting intensity in the studied patients' rooms. Moreover, it examined the validity of the questionnaire by the referee validity and internal consistency and examine the reliability of the questionnaire.

This chapter concluded that the type of luminaire used in all patient rooms in Alshifaa hospital (surgery, internal medicine, heart care) is fluorescent (FL40T9D/38) with CCT color temperature 6.500 K, Ra 74 and color is daylight color. Moreover the controlling system is by manual switches. The results show that the questions of the questionnaire were suitable and highly consistent and valid for conducting this study. In addition, it indicates that the questionnaire is reliable and the research is satisfied to apply it on the sample of the study.

Chapter 5

Results of the study

5.1 Introduction

The aim of this chapter is to investigate the effects of lighting quantity and quality design consideration and lighting fixtures characteristics on patients' well-being –visual, biological and psychological- in surgery, internal medicine and heart care department in Al-shifa Hospital. In addition, It measures the general patients' satisfaction about existed lighting. And clarifying the points of view for patients' about current lighting and most important preferences for him, and knowing his view point about lighting quantity and quality, in addition, clarify the impact of lighting on feeling about surrounding atmosphere which have impact on patient well-being.

This chapter includes the study results, as well as the discussion of the results. Moreover, it investigates the relationship between factors that affected patients' wellbeing. In addition, it includes the results of lighting intensity measurements that measured by LuxMeter app as a validation tool

5.2 First Field, The effects of lighting intensity level on patient's well-being (Visual, Biological, and Psychological):

This field includes (16) questions. The aim of these questions is to determine the effects of lighting intensity level on patients in Al-shifa hospital -in surgery, internal medicine and heart care department on patient's well-being(visual, biological, and psychological health).Moreover, to determines the current situation of lighting design in Al-shifa rooms according to the patients' viewpoint. The questions were divided as seen in the following table (5.1) to achieve the goals of this field:

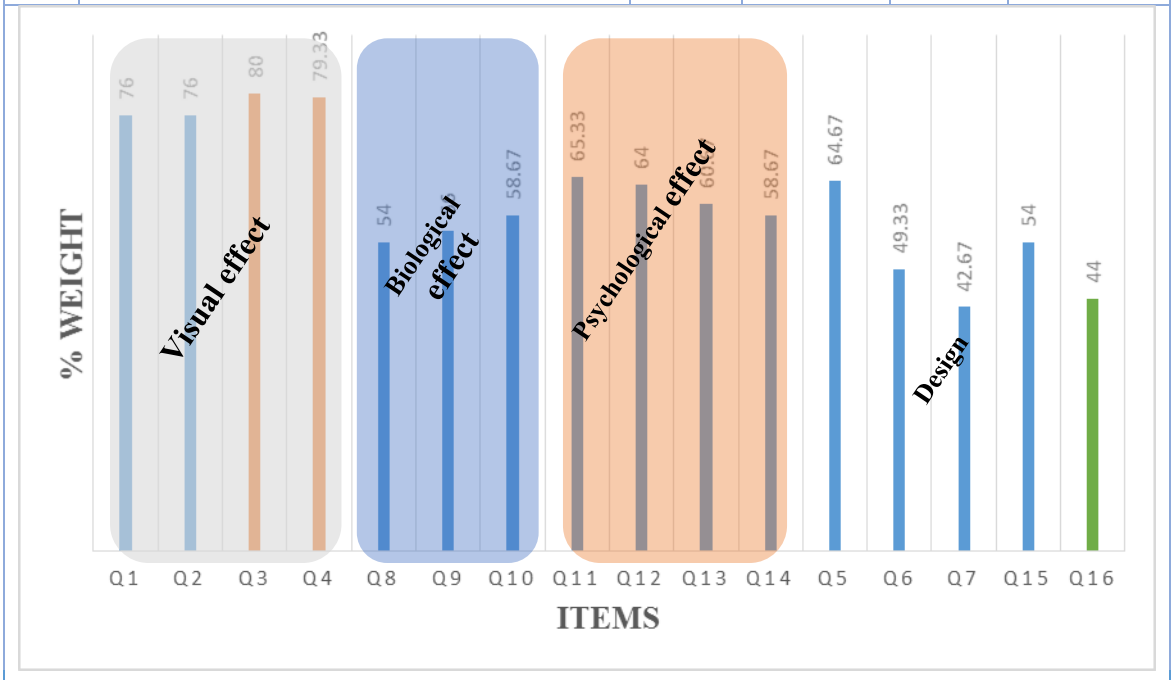
Table 5.1: Division the question into groups in the first field			
The effect of lighting intensity level	On visual	N of questions 1_4	Inquire the level of lighting intensity for seeing and perform different tasks that patient do in the room
	On biological	8_10	Inquire the effect of lighting intensity level on eyes. In addition, what damages can cause?
	On psychological	11-14	Inquire about the effects of lighting intensity level on patient emotional and psychological comfort (comfortable, active, drowsiness and nervous).
Lighting design situation		5_7,15,16	Inquire about the design and distribution of lighting in rooms and the form of lighting units and the way of controlling it according to the patients' viewpoint

5.2.1 Results

To achieve the results, the researcher used the frequencies, the sum of responses, means, std. deviation, percentage weight and rank of each question from the questionnaire. Table (5.2) shows that:

Table 5.2: The sum of responses, means, std. deviation, % weight and rank of each question from of the first field					
No.	Questions	Mean	Std. Deviation	% weight	rank
1	Level of lighting intensity is enough to perform vision.	3.800	0.887	76.00	3
2	Level of lighting intensity is enough to perform reading.	3.800	0.847	76.00	4
3	Level of lighting intensity is enough to perform movement.	4.000	0.587	80.00	1
4	Level of lighting intensity is enough to perform eating	3.967	0.556	79.33	2
5	Number of light units is enough	3.233	1.251	64.67	6
6	Shapes of lighting units are beautiful and attractive.	2.467	0.973	49.33	14
7	Variety of light units is good	2.133	0.730	42.67	16
8	There are undesirable reflected lights from some surfaces in the room	2.700	0.988	54.00	12
9	The lights cause eye sensitivity	2.800	1.031	56.00	11

10	The lights cause eye stress.	2.933	1.048	58.67	9
11	lighting Intensity level makes you feel comfortable	3.267	0.907	65.33	5
12	lighting Intensity level makes you feel active and vital	3.200	0.925	64.00	7
13	lighting Intensity level makes you feel drowsiness and laziness	3.033	0.890	60.67	8
14	lighting Intensity level makes you feel nervous	2.933	0.980	58.67	10
15	Level of lighting intensity is sometimes not enough	2.700	1.119	54.00	13
16	You can control lighting intensity in the room	2.200	1.375	44.00	15
	Total degree	51.033	8.147	**63.79**	



Visual effect	77.8%	**Biological**	56.2%	**Psychological**	62.15%	**Design**	50.9%

Figure 5.1: The percentage weight of each question from of the First field

5.2.2 Discussion

According to table, (5.2) and figure (5.1). Generally, there is no large variation in the results, where the Mean reaches (51.003), the effects of this field on well-being have percent weight (63.79%).In addition, the most two frequented questions #3&4 were located in the group related to visual effects and the least two frequented questions #16&7 were located in the group related to design.

Moreover, the most frequented group is related to the visual effects with the average weight of(77.8%).In addition, this group have the most two frequented question #3, (**level of intensity lighting is enough to perform movement**),occupied the first rank with percent weight (80.00%).In addition, #4 (**Level of lighting intensity is enough to perform eating**), occupied the second rank with percent weight (79.33%).

These results were attributed to, the level of lighting intensity in all rooms in the surgery department which is enough to meet the requirements. In addition, natural and artificial lighting are available in the patients' rooms, which are east-west orientated with enough openings to let natural light into the rooms. As seen in figure (5.2) the surgery department has 40% of moderate level of lighting and 53% of high lighting level.

The level of lighting intensity in the internal medicine department is not enough to meet the requirement where most rooms lack natural lighting and have poor artificial lighting. Some patients said that the lighting level is suitable for carrying out their tasks because their tasks are done by the help of their companions so the level of lighting does not affect them. From figure (5.2), it was found that the internal medicine department has 56% of low lighting and 44% of moderate lighting.

The level of lighting intensity in the heart care department is enough to meet the requirement despite being mainly dependent on the artificial lighting, but it is suitable for the patients to carry out their tasks. As shown in figure (5.2) it was found that the department has 50% of moderate lighting level and 50% of high- lighting level.

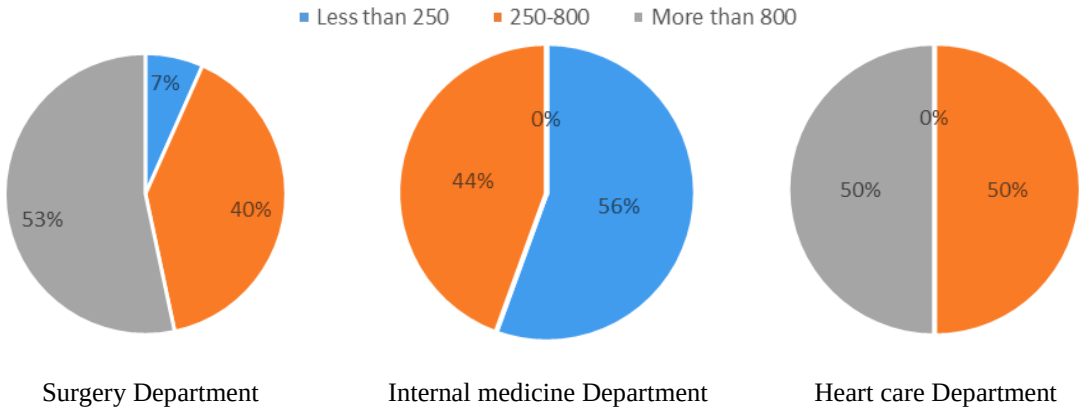


Figure 5.2distribution of lighting intensity ratios in Surgery, internal medicine and heart care

By interpretation between the questionnaire and measurements of lighting intensity it was found that, as shown in table (5.3) and figure (5.3), the better the patients' rooms are well-lit the more the patients have a sense of satisfaction regarding the level of illumination in their rooms. But the measurements for high levels above 2000 lux were not taken, considered as it is unhealthy and annoying, and this result just for measurements that below 2000 lux.

Table 5.3: relationship between lighting intensity and general satisfaction

	N	Mean	Std. Deviation	% weight
Less than 250	6	105.333	9.812	60.19
251-800	13	109.615	15.213	62.64
More than 800	11	118.818	18.819	67.90
Total	30	112.133	16.243	64.08

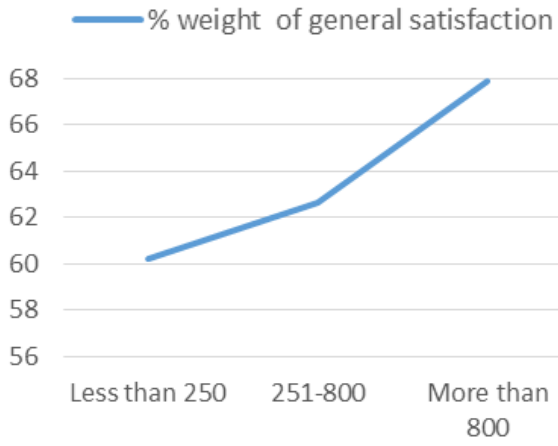


Figure 5.3: relationship between lighting intensity and general satisfaction

The group related to Psychological effects reached average weight (62.15%). Although the level of lighting intensity was appropriate, the quality of design does not follow the standards of lighting design in patients' room that was not using indirect light components on ceiling and walls.

The group is related to biological effects, which have average weight of (56.2%). These results are attributed to, the lighting that is used in studied departments was direct lighting, which not follow the criteria about preventing mirror effects and reflections Moreover, and the patient spends his time prone on his back, so direct lighting annoying and causes eye stress.

Finally, The group related to the patients' viewpoint about existed lighting design inside patients' room have the least average weight of (50.9%), In addition; this group have the two least frequented questions #16 "**You can control lighting intensity in the room**" which occupied the fifteenth rank with percent weight (44.00%). These results are attributed to, the distribution of lighting, which does not follow applicable rules and standards. The researcher found one or two switches; one of them controls all lighting units in the patients' rooms over the patient's bed and the other to control lighting units in corridor, which reduces the level patients' control of lighting. Moreover, the existence of other patients in the room reduces the ability to control the level of lighting because their

needs for lighting and tasks vary. For example, some patients prefer lighting while sleeping and other do not. In addition, the quality of design does not follow consideration of lighting design to provide task lighting above or next to every bed in order to allow the patients to do their tasks at night. In addition, there is not central lighting control system with monitoring. Moreover, there is no maximizing levels of lighting by pressing the button at the patient's bedside or via additional light components.

In addition, question #7 "**Variety of light units is good** "which occupied the last rank with percent weight of (42.67%).The percent weight of the total degree is (63.79%). These results are attributed to, the lighting design which does not follow design quality in designing healthcare lighting where it was founded that all of the lighting is fluorescent ambient lighting and there is no task or accent lighting in the patient rooms. In addition, there is not existence of bedside lighting, which gives variety, and flexibility, to meet the patients' requirements and feeling of comfort.

From the above-mentioned points, it was concluded that, the top rated effects of lighting intensity on well-being founded in Al-shifaa departments– surgery, internal medicine and heart care- for visual effects have percent weight of (77.8%). Followed by psychological effects with percent weight of (62.15%), then biological effects with percent weight of (56.2%), which show that lighting design in these departments met quantity requirements and ignored quality requirements in lighting design. This became clear by the satisfaction rates about existed design that has percent weight (50.9%).

This field have effects on patients' well-being, with percent weight of (63.8%) from the level of lighting intensity in -surgery, internal medicine, and heart care departments in Al-Shifa hospital. This is attributed to the electricity crisis in Gaza, which creates the feeling of sufficiency and satisfaction on any lighting level, without taking consideration its efficiency or if it fits with the patients' well-being, compared to the dark houses that lack electricity.

Quality of lighting design includes distribution of lighting units, and the existence of multiple lighting source inside the patients' room. In addition, using layers system in lighting design to be harmonious with the patient requirement and the existence of lights such as task, and accent lighting. In addition, the availability of indirect ambient lighting and reducing glare on the eye lead to increasing the level of the satisfaction with lighting and visual comfort to promote the well-being of the patient. Moreover, whenever the level of lighting intensity increases the satisfaction of lighting design will increase.

5.3 Second Field, The Effects of color and temperature of lighting on the patients' well-being:

This field includes (15) questions. The aim of these questions is to determine the effects of color and temperature of lighting in patients' room in Al-shifa hospital -in surgery, internal medicine and heart care department- on their visual, psychological, emotional and feelings about place. In addition, to determine the current situation of lighting design in these rooms according to the patients' viewpoint. The questions were divided as seen in the following table (5.4) to achieve the goals of this field:

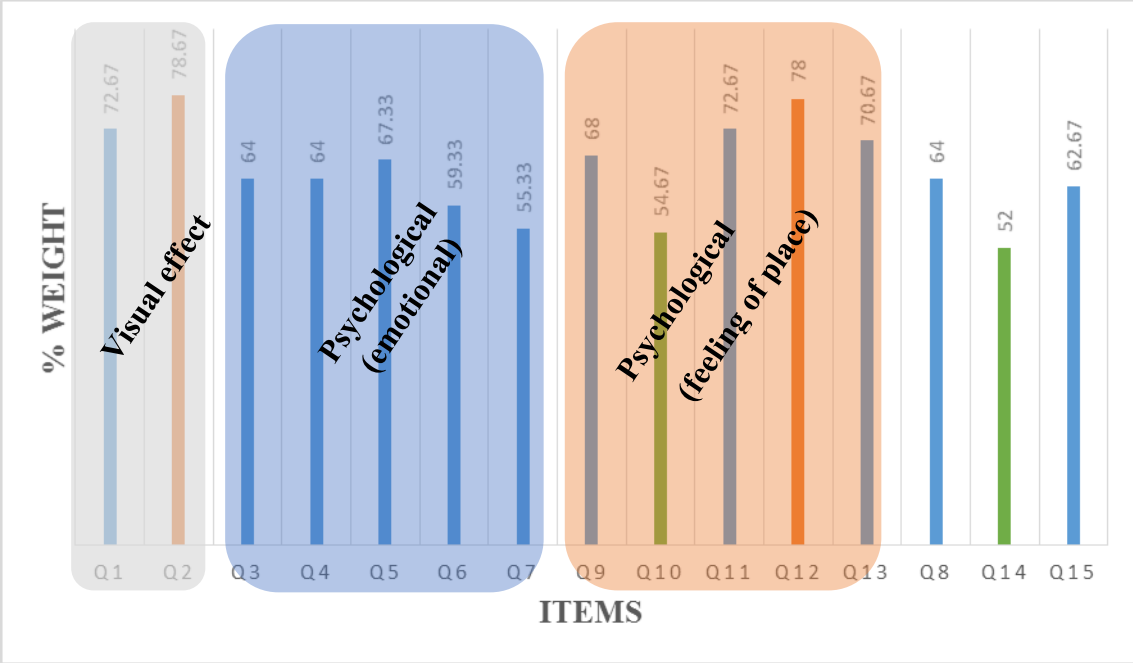
Table 5.4: Division the question into groups in the second field			
The effect of color lighting level	On visual	N of questions 1_2	Inquire the efficiency of lighting color and CCT for existed lighting to see three dimension clearly and effects of Ra on seeing colors clearly
	On psychological (emotionally)	3_7	Inquire the effect of lighting color and CCT on the emotions (Relax, mood, wake)
	On psychological (atmosphere-perception)	9-13	Inquire effects of lighting color on feelings about place (Beauty, formality, safety)
Lighting design situation		8,14,15	Inquire if lighting fits with patient rooms color and distribution of lighting color in rooms and the way of controlling it according to the patients' viewpoint

5.3.1 Results

The researcher used the frequencies, the sum of responses, means, std. deviation, and the percentage weight and rank of each question from the questionnaire. Table (5.5) shows the results:

Table 5.5: The sum of responses, means, std. deviation . And the % weight and rank of each question from of the second field					
No.	**Questions**	**Mean**	**Std. Deviation**	**% weight**	**rank**
1	Color of lighting is appropriate to see things clearly	3.633	0.890	72.67	4
2	Color of lighting is appropriate to see colors as they really are.	3.933	0.583	78.67	1
3	Color and temperature of lighting makes you feel active and vital	3.200	0.847	64.00	8
4	Color and temperature of lighting makes you feel calm and relaxed	3.200	1.095	64.00	9
5	Color and temperature of lighting makes you feel awake.	3.367	0.890	67.33	7
6	Color and temperature of lighting makes you feel pleased.	2.967	0.890	59.33	12
7	Color and temperature of lighting makes you feel upset and worried	2.767	0.971	55.33	13
8	Lights' color fits with the colors of the room	3.200	0.997	64.00	10
9	Colors of lights makes you feel comfortable	3.400	1.070	68.00	6
10	Feeling of the beauty of the place by colors of lights.	2.733	0.980	54.67	14

11	Feeling of the formality of the place by colors of lights	3.633	0.928	72.67	3
12	Feeling of the safety of place by colors of lights.	3.900	0.548	78.00	2
13	Feeling of warmth of place by colors of lights	3.533	0.900	70.67	5
14	You can control colors of lighting in the room	2.600	1.329	52.00	15
15	Colors of lighting control in the room makes you feel comfortable	3.133	1.252	62.67	11
	Total degree	**49.667**	**6.738**	**66.22**	



Visual effect	75.67 %	**Psychological (emotional)**	61.998%	**Psychological (feeling of place)**	68.802%	**Design**	59.55%

Figure 5.4: The % weight of each question from of the second field

5.3.2Discussion

According to table (5.5) and figure (5.4), generally, there are no vast variations in the results where the Mean reaches (49.667), the effects of this field on the well-being have weight percent of (66.22%). In addition, The most two frequented questions #2&12were located in the group related to visual effects and psychological feeling of the place, but the least two frequented questions #10&14 were located in the group related to design and psychology of the feeling of the place.

Moreover, the most frequented group is related to the visual effects average weight of(75.67%), this group has the most frequented question #2 (**Color of lighting is**

appropriate to see colors as they really are). which occupied the first rank with percent weight of (78.67%).These results are attributed to the fact that the lighting used in the entire department is fluorescent which has moderate color rendering (Ra=74).

Followed by the group related to psychological of the feeling of the place have average weight of (68.8%), Question #12 (**Colors of lights feels the safety of place**), has the second most frequented percent weight (64%).These results are attributed to the fact that the lighting color of the fluorescent is daylight and CCT color temperature is 6.500 K. that relieves the patients and makes them feel safe. In addition, the existence of lighting makes humans feel safe.

On the other hand, this group have the least frequented question #10 (**Feeling of the beauty of the place by colors of lights**), which occupied the fourteenth rank with percent weight of (54.67 %). These results are attributed to the fact that the daylight color provides a feeling of safety but it also provides a neutral feeling towards the place. In addition, the lack of diversity in lighting color and the shapes of the lighting units provides a feeling of boredom. Followed by the group related to psychological effects on emotions with average weight of (61.9%).

Finally, The group related to the patients' viewpoint about existed lighting design inside patients' rooms have the least average weight of (59.55%),In addition, this group have the second least frequented question #14 (**You can control colors of lighting in the room**), which occupied the last rank with percent weight (52%).These results are attributed to the fact that the lighting design does not follow design quality in designing healthcare lighting because it was found that all of the lighting is fluorescent ambient lighting and there is no diverse of lighting fixtures by color. Moreover, there is no system to control or change the color of lighting.

From above it concluded the type of existed lighting (Fluorescent)in surgery, internal medicine and heart care departments in Al-shifa' hospital was suitable, whereas Ra= 74, and color of lighting is daylight which fits with patients' rooms, but there is a problem in lighting design, that is represented in the absence of variety in colors of lighting, Which is needed by the patient. In addition, there is no controlling method in colors of lighting.

Lighting has effects on the feeling of the place more than it effects on emotions of patient especially feeling the beauty of the place and hospitality. In addition, Good design according to design considerations and standards which include design quality specialized in type and color of lighting leads to improving the well-being of patients, which in return increases the level of public satisfaction, visual comfort, the feeling of the place, mood, and psychological comfort**.**

5.4 Third Field: The Effects of lighting on patients' sleeping.

This field includes (4)questions, the aim of these questions is to determine the effects of lighting in patients rooms at Al-shifa' hospital in surgery, internal medicine and heart care departments on their biological well-being by determinationthe effects of lighting on patients' sleep and the current lighting design in these rooms at sleeping

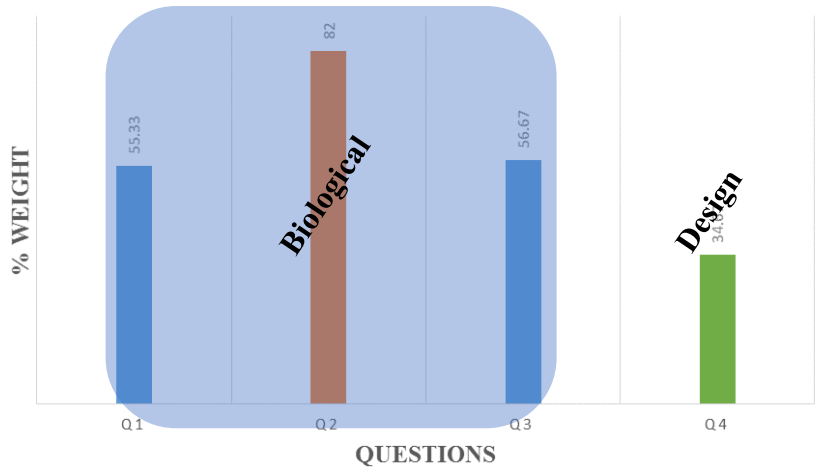
timeaccording to patients' viewpoint. These questions weredivided as seen in the following table (5.6) to achieve the goals of this field.

Table 5.6: Division the question into groups in the third field		
Question	N of Q	
The effect of color lighting level on biological	1_3	Inquires the effect of current lighting on patient sleeping and comfortable during sleeping
Lighting design situation	4	Controlling of lights during sleeping

5.4.1 Results

To achieve the results, the researcher used the frequencies, the sum of responses, means, std. deviation, the percentage weight and rank of each question from the questionnaire. Table (5.7) shows the results:

Table 5.7: The sum of responses, means, std. deviation. And the % weight and rank of each question from of the third field					
No.	**Questions**	**Mean**	**Std. Deviation**	**% weight**	**rank**
1	Ican sleep when the current lighting on	2.767	1.073	55.33	3
2	I feel more comfortable when lights are off	4.100	0.607	82.00	1
3	I feel comfortable in existing lighting at sleeping time	2.833	0.986	56.67	2
4	I can control color of lighting at sleeping time	1.733	1.015	34.67	4
	Total degree	**11.433**	**2.674**	**57.17**	



Biological	%64.6	**Design**	%34.67

Figure 5.5: The % weight of each question from of the third field

5.4.2 Discussion

According to table (5.7) and figure (5.5);generally, there is no large variation in the results, where the Mean reaches (11.43).The effects of this field on well-being have percent weight (57.17%), In addition, the most frequented for result was related to the biological effects and the average weight was (64.6%), this group have the most frequented question #2 (**I feel more comfortable when lights are off**), which occupied the first rank with percent weight (82%). These results are attributed to the fact that the humans need to sleep in the dark, which is consistent with the human body that produces Melatonin Hormone only in the dark, which helps people to sleep. Moreover, this point is consistent with (Unwin, 2011), study that suggested the importance of providing darkness or dimmed lights in order to make the patients' comfortable and help them to sleep well.

Followed by the group related to patients' viewpoint about existed lighting design in patients sleeping rooms was occupied the least rate with average weight (34.67%), In addition, this group have the least frequented question #4 (**I can control color of lighting at sleeping time**) which occupied the last rank with percent weight (34.67%). These results are attributed to the fact that the good design of lighting is not applied and there are no several sources of lighting in the room for every patient so they can control the lighting at sleeping time.

So it is concluded that, the existed lighting design in surgery, internal medicine and heart care departments in Al-shifa' hospital does not follow the design quality in design consideration, where appropriate lighting was not available for patients sleeping, and the controlling method is not available. Therefore, Good design includes the availability of dimmed lights during sleeping time, which increases public satisfaction level about lighting and increases the biological effects on patients' well-being inside the rooms during sleeping, healthy sleeping can help to improve the patients' well-being by making the human body produce melatonin hormone in darkness.

5.5 Fourth Field, The Effects of integration between natural and artificial light on patients' well-being (Visual, Biological, and Psychological).

This field includes (8) questions. The aim of these questions is to determine the effects of integration between natural and artificial lighting in patients' room in Al-shifa' hospital in surgery, internal medicine and heart care departments on their psychological, emotional and feelings about place. In addition, to determine the current situation of lighting design in these rooms according to patients' viewpoint. These questions are divided as seen in the following table (5.8) to achieve the goals of this field:

Table 5.8: Division the question into groups in the fourth field

The effect of integration between natural and artificial	On psychological (emotional)	N of Q 1_2	Inquires the effects of integration between natural and artificial lighting on emotion (relax, mood, wake)
	On psychological (atmosphere perception)	**3_5**	Inquires the effects of integration between natural and artificial lighting on atmosphere perception (Beauty, formality, safety).

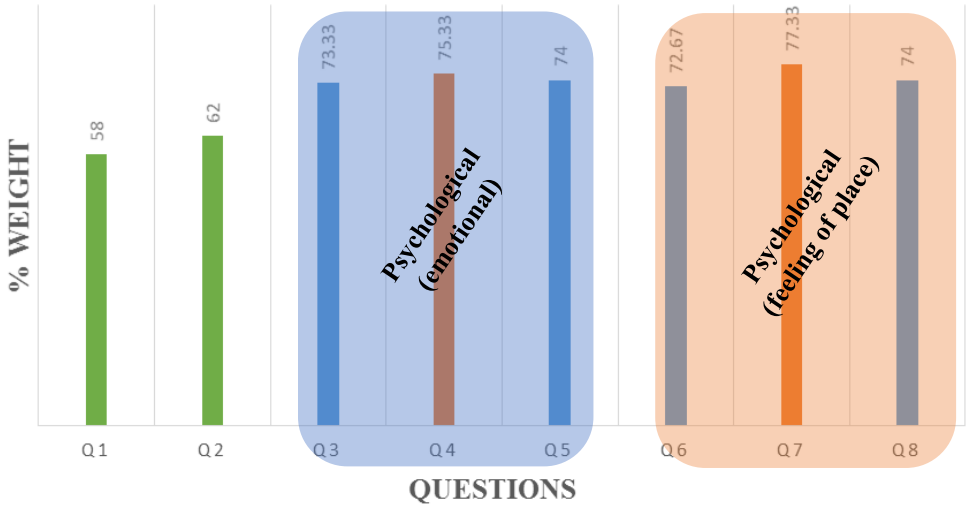
Lighting design situation	**6_8**	Inquires the ability of controlling of integration between natural and artificial lighting according to patient.

5.5.1 Results

To achieve the results, the researcher used the frequencies, the sum of responses, means, std. deviation, percentage weight and rank of each question from the questionnaire. Table (5.9) shows the results:

Table 5.9: The sum of responses, means, std. deviation. And the % weight and rank of each question from of the fourth field

No.	Questions	Mean	Std. Deviation	% weight	rank
1	The level of lighting intensity of artificial lights changes appropriately with natural lights during day	2.900	0.960	58.00	8
2	Color of artificial light is integrated with colors of natural lighting during day	3.100	0.960	62.00	7
3	Integration of natural lighting and artificial lighting makes you feel active and vital	3.667	0.661	73.33	5
4	Integration of natural lighting and artificial lighting makes you feel comfortable	3.767	0.626	75.33	2
5	Integration of natural lighting and artificial lighting makes you feel calm and relaxed	3.700	0.952	74.00	4
6	Integration of natural lighting and artificial lighting makes you feel the beauty of the place	3.633	0.765	72.67	6
7	Integration of natural lighting and artificial lighting makes you feel the safety of the place	3.867	0.681	77.33	1
8	Integration of natural lighting and artificial lighting makes you feel the formality of the place	3.700	0.952	74.00	3
	Total degree	**28.333**	**4.318**	**70.83**	



Design	60%	**Psychological (emotional)**	%74.2	**Psychological (feeling of place)**	%74.6

Figure 5.6: The % weight of each question from of the fourth field

5.5.2 Discussion

According to table (5.9) and figure (5.6), generally, there is no large variation in the results, where the mean reaches (28.3). The effects of this field on well-being have weight percent is (70.8%). And, The most frequented for the group is related to the psychological of the feeling of the place, where its average weight is(74.6%), In addition, this group have the most frequented question #7 (**Integration of natural lighting and artificial lighting makes you feel safety of the place**), which occupied the first rank with percent weight is (77.33%).

Followed by the group that is related to psychological effects on emotion where the average weight reached (74.2%), In addition, this group have the second most frequented question#4 (**Integration of natural lighting and artificial lighting makes you feel comfortable**), which occupied the second rank with percent weight (75.33%).

These results are attributed to, first, the integration between the natural and artificial lighting provides a feeling of safety in the place and this suits the human psychology, which feels safe in the light and fear in the dark. Second, both natural and artificial lighting in the surgery and heart care buildings make the patients feel safe. As for the internal medicine building, which lacks natural lighting in the rooms and poor artificial lighting, but a courtyard provides a feeling of safety in the space, Moreover, the integration between artificial and natural lighting provide comfort. In addition, the Cortisol hormone produce in the light makes people active.

Finally, the question that is related to the patients' viewpoint about existed lighting design inside patients room have the least frequented average weight is(60%),In addition, this group have the two least frequented question #1 (**The level of lighting intensity of artificial lights changes appropriately with natural lights during day**),which occupied the last rank with percent weight is (58%).Question #2 (**Color of artificial light**

is integrated with color of natural lighting during day), which occupied the seventh rank with percent weight is (62%).

These results are attributed to the color of natural daylight changes during the day from cold to neutral to warm white. On the contrary, the artificial lighting in patients' rooms' remains fixed and does not integrate with the natural lighting. Also, the level of natural lighting changes during the day from dimmed to moderate to high while the artificial lighting remains fixed and does not integrate with the natural lighting. Sometimes the natural and artificial lightings integrate while in other times the artificial lighting is below or above the level of the natural lighting. It is difficult to control the level of artificial lighting in the rooms, so that makes it hard to control the integration between the artificial and natural lighting.

It is concluded that, existed lighting design in surgery, internal medicine and heart care departments in Al-shifa' hospital does not follow the design quality in design consideration in terms of controlling lighting by integration. Moreover, it was founded that patients prefer natural lighting to artificial lighting.

Integration between natural and artificial lighting affected on the feeling of place more than the emotion for patients especially feeling beauty of the place and hospitality. In addition, Good design, which includes controlling integration between natural and artificial lighting helps to increase the satisfaction level for patients about lighting and increases psychological effects on well-being inpatients' rooms.

5.6 Fifth Field: The Suggested solutions

This field includes (11) questions. The aim of these questions is to know the viewpoint of patients' about suggested solutions to improve the satisfaction level about lighting in patients' room. Therefore, the questions are divided as seen in the following table (5.10) to achieve the goals of this field:

Table 5.10: Division the question into groups in the fifth field

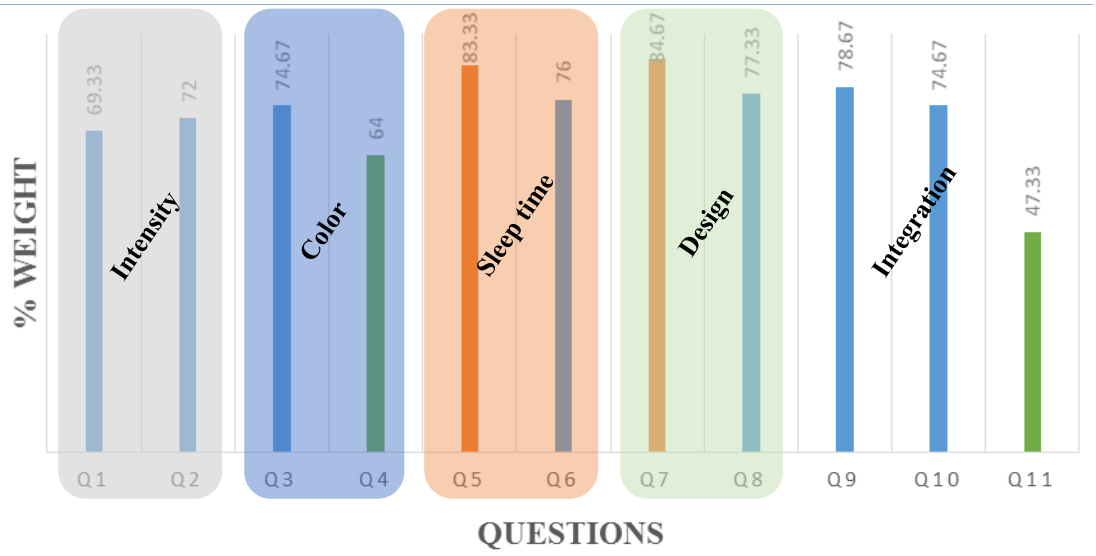
Solutions about	Lighting intensity.	N of Q **1_2**	inquires the patients' viewpoint about lighting intensity suggested solutions and how much patient prefers it,
	Lighting Color	**3_4**	inquires the patients' viewpoint about color of lighting suggested solutions and how much patient prefers it,
	Solutions about preferred lighting at sleeping.	**5-6**	
	Lighting design.	**7-8**	inquires the patients' viewpoint about lighting design suggested solutions and how much patient prefers it,
	Integration between natural and artificial lighting.	**9_11**	inquires the patients' viewpoint about integration between natural lighting and artificial lighting suggested solutions and how much patient prefers it,

5.6.1 Results

To achieve the results, the researcher used the frequencies, the sum of responses, means, std. deviation, and the percentage weight and rank of each question from the questionnaire. Tables (5.11) shows the results:

Table 5.11: The sum of responses, means, std. deviation . And the % weight and rank of each question from of the fifthfield

No.	strategies	Mean	Std. Deviation	% weight	rank
1	I prefer to change light intensity automatically during the day	3.467	1.383	69.33	9
2	I prefer variety of lighting color in the room	3.600	1.070	72.00	8
3	I prefer to control color of lighting in the room	3.733	0.944	74.67	6
4	I prefer to change color of lights automatically during day	3.200	1.324	64.00	10
5	I prefer to turn the lights off at sleeping time	4.167	1.085	83.33	2
6	I prefer to change color of lighting at sleeping time	3.800	1.157	76.00	5
7	I prefer variety of lighting distribution in the room	4.233	0.858	84.67	1
8	I prefer variety in lighting units' shapes in the room	3.867	0.776	77.33	4
9	I prefer integration between natural and artificial lighting	3.933	0.907	78.67	3
10	I prefer to control natural and artificial lighting	3.733	0.907	74.67	7
11	I prefer artificial lighting to natural lighting	2.367	1.273	47.33	11
	Total degree	**40.100**	**5.365**	**72.91**	



Intensity	70.66%	**Color**	*69.33%*	**Sleep time**	79.6%	**Design**	81%	**Integration**	66.89%

Figure 5.7: The % weight of each question from of the Fifth field

5.6.2 Discussion

According to table (5.11) and figure (5.7), generally, there is no large variation in the results, where the Mean reaches percent is (40.1).The effects of this field on well-being have weight percent of (72.91%). and, the most two frequented questions #5&7 were located in the group related to solutions of lighting design and preferences at sleeping while the least two frequented questions # 4&11 were located in the group related to integration and color.

The most frequented group is related to the solutions about lighting design where it is average weight is(81%), In addition, this group have the most frequented question#7 (**I prefer variety of lighting distribution in the room**),which occupied the first rank with percent weight (84.67%).

These results are attributed to, First, The good design of the room with varied sources of lighting is one of the most affecting factors in the satisfaction level of the patients because it provides control over the level and the color of lighting to be consistent with the patients psychological mood. It also provides dimmed lighting at night for sleeping and task lighting for staff to treat patients without bothering other patients.

Followed by the group related to patients lighting preferences at sleeping time, where the average weight reached (79.6%), In addition, this group have the most frequented question#5 (**I prefer to turn the lights off at sleeping time**) which occupied the second rank with percent weight is (83.33%). These results are attributed to, patients' need darkness at night to produce the Melatonin hormone that helps the body to relax and peacefully sleep.

Followed by the group related to lighting intensity have the most frequented average weight of(70.66%), Followed by group related to solutions of lighting color.

where it is average weight is(70.66%).In addition, this group have the least frequented question #4(I prefer to change color of lights automatically during day) which occupied the tenth rank with percent weight of(64%).These results are attributed to, the patients' need to control the level and color of lighting according to their psychological mood without automatically changing during the day.

Finally, there is a group related to solution of integration between natural and artificial lighting which occupied the least rank with average weight (66.89%), In addition, this group have the second least frequented question#11 (**I prefer artificial lighting to natural lighting**) which occupied the last rank with percent weight(47.3%). These results are attributed to the fact that the natural lighting remains the preferred kind of lighting as it provides feelings of satisfaction, comfort and safety.

From the above it is concluded that, good lighting design is the first need for patient in their room where multiple and varied light units must be available in the rooms, light sources must follow quality and quantity criteria of lighting design so it can increase the public satisfaction about lighting and its effects on well-being. In addition, patients' need to control the lighting intensity according to their psychological state and mood that supplies them with psychological and biological comfort which promote their well-being. Moreover, presence of multiple colored lighting and letting the patient use them freely and to choose the appropriate color can improve their well-being. Presence of quantity and quality criteria of lighting intensity and choosing the color and type helps the patients to get comfortable rest that can increase the biological comfort and make them get well fast. In addition, patients' need to control the integration between natural and artificial lighting increases the design efficiency and increases psychological comfort of the patient.

5.7 General satisfaction

To inquire the general level of satisfaction toward existed lighting in surgery, internal medicine and heart care departments in Al-shifa' hospital, The researcher used the frequencies, the sum of responses, means, std. deviation, and the percentage weight and rank of each question in the questionnaire. Table (5.12) shows the results:

5.7.1 Results

Table 5.12: The sum of responses, means, std. deviation . And the % weight and rank of each question from of the general satisfaction

strategies	**Sum**	**Mean**	**Std. Deviation**	**% weight**	**rank**
Surgery building	1700	3.24	14.994	64.76	2
Internal Medicine building	918	2.91	11.079	58.29	3
heart Care building	746	3.55	18.348	71.05	1
Total	3364	3.20	16.243	64.08	

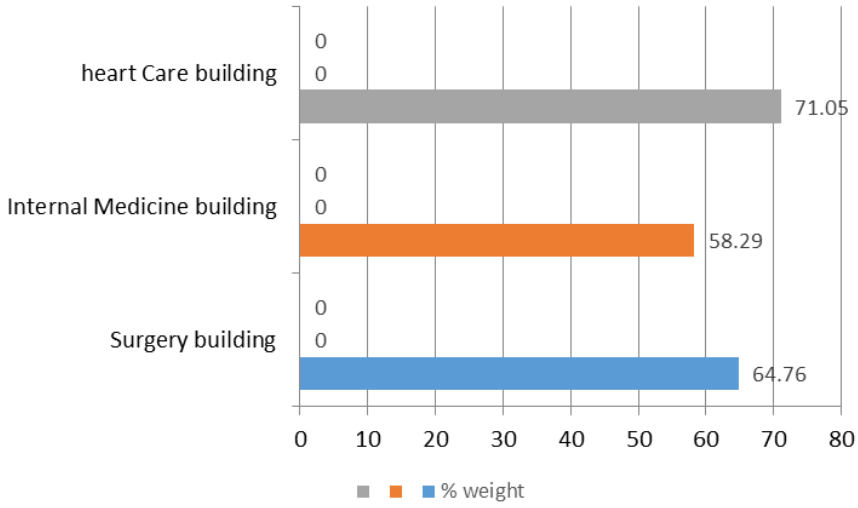


Figure 5.8: The % weight of general satisfaction abouteach building

5.7.2 Discussion

According to table (5.12) and figure (5.8),The heart care department has the most frequented with percent weight of (71.05%) followed by the surgery department which has percent weight (64.76%). and, the internal medicine care has the least frequented with percent weight (58.29%).These results are attributed to the heart care building has both artificial and natural lighting, but it mostly depends on artificial lighting. Where every bed has special ambient light in addition to other lights in corridor and in the patients' room provides good level of lighting in the room, and this is why the building has the highest level of satisfaction in comparison to other buildings.

In addition, the surgery building also has both artificial and natural lighting because the rooms are oriented in the eastern and western sides of the building with suitable openings to allow enough natural light pass through the rooms, which made it possible not to use the artificial lighting.

In addition to, the internal medicine building has poor artificial and natural lighting. In addition, the electricity shortage in Gaza Strip affected the level of general satisfaction towards lighting where some patients said that it is better to have whatever lighting compared with no lighting at all.

5.8 Consistency of results

In order to know if there are any statistically significant differences at ($\alpha \leq 0.05$) at the Effect of Lighting on patients' Well-being due to: (Gender (male, female), Age (16-29, 30-39, more than40),stay period, Orientation (north, south, east, west),and Building (surgery, internal medicine, heart care)? or not.

The researcher used Mann Whitney Test (gender, stay period) and Kruskal-Wallistest Test (age, orientation) Table (5.13) shows that and See (appendix 3) for more details:

Table 5.13: Mann Whitney Test (gender, stay period) and Kruskal-Wallistest Test (age, orientation)

Field	Gender	Mean	Sig.	Age	Mean	Sig.	Stay period	Mean	Sig.	Orientation	Mean	
Effects of lighting level on patients' health (Visual, Biological, Psychological)	Male	3.086	Not sig.	16-29	3.176	Not sig.	1-9	3.153	Not sig.	east	3.181	Not sig.
				30-39	3.213		More than 10	3.289		west	3.354	
	female	3.308		40 ≤	3.192					north	2.906	
										south	3.097	
Effects of color and temperature of lighting on the patients' health	Male	3.317	Not sig.	16-29	3.194	Not sig.	1-9	3.245	Not sig.	east	3.473	Not sig.
				30-39	3.253		More than 10	3.492		west	3.489	
	female	3.305		40 ≤	3.424					north	2.800	
										south	3.067	
Effects of lighting on patients' sleeping	Male	2.75	Not sig.	16-29	2.750	Not sig.	1-9	2.750	Not sig.	east	2.950	Not sig.
				30-39	2.950		More than 10	3.156		west	3.083	
	female	2.982		40 ≤	2.911					north	2.500	
										south	2.611	
Effects of integration between natural light and artificial light on patients' health (Visual, Biological, Psychological).	Male	3.547	Not sig.	16-29	3.375	Not sig.	1-9	3.500	Not sig.	east	3.613	Not sig.
				30-39	3.725		More than 10	3.656		west	3.667	
	female	3.536		40 ≤	3.607					north	2.750	
										south	3.514	
Suggested solution	Male	3.528	Not sig.	16-29	3.835	Not sig.	1-9	3.748	Not sig.	east	3.536	Not sig.
				30-39	3.636		More than 10	3.364		west	3.465	
	female	3.779		40 ≤	3.500					north	3.500	
										south	3.980	

According to table (5.13);

No statistical significant differences between male and female in all field due to Gender. These result are attributed to the fact that, Both males and females need lighting without any difference for carrying out their tasks with the same level and they are both affected by lighting in the same way and prefer to sleep in the same level of lighting. Finally, they both produce the Melatonin hormone in the dark and the Cortisol hormone at daytime.

No statistical significant differences in all fields due to age. These results are attributed to the fact that, Most of the patients are young people less than 60 years old. The level of lighting in the surgery and heart care buildings is good and it suits their ages so there is no difference in effects due to age.

No statistical significant differences in all fields due to Orientation. These result are attributed to the fact that, both surgery and heart care buildings have good artificial and natural lighting and the rooms are east- west oriented while the internal medicine building has little natural lighting and poor artificial lighting and the rooms are north-south oriented. According to the results, there were no differences due to orientation in the first, third, fourth and fifth fields. In the second field there is a non-statistically significant difference due to the natural lighting effects because of the building orientation and its effect on the color of the lighting in the rooms.

No statistically significant differences in all fields due to stay period in the rooms. These results are attributed to the fact that, the impression of lighting remains intact from the first day until they leave the hospital without being affected by the number of days.

Due to building (Surgery building**,** Internal Medicine building **and** heart Care building**).**

The researcher used **Kruskal-Wallistest**table (5.14) shows the results:

Table 5.14: Kruskal-Wallis Test results

Field	**building**	**N**	**Mean**	**Mean Rank**	**Chi-Square**	**Sig. value**	**Sig. level**
Effects of lighting level on patients' health (Visual, Biological, Psychological)	Surgery building	15	3.179	15.933	3.677	0.159	Not sig.
	Internal Medicine building	9	2.944	11.556			
	heart Care building	6	3.583	20.333			
Effects of color and temperature of lighting on the patients' health	Surgery building	15	3.387	16.900	8.515	0.014	Sig. at 0.05
	Internal Medicine building	9	2.970	8.944			
	heart Care building	6	3.633	21.833			
	Surgery building	15	2.917	16.667	1.903	0.386	Not sig.

Effects of lighting on patients' sleeping	Internal Medicine building	9	2.583	12.222			
	heart Care building	6	3.125	17.500			
Effects of integration between natural light and artificial light on patients' health (Visual, Biological, Psychological).	Surgery building	15	3.525	15.800	0.419	0.811	Not sig.
	Internal Medicine building	9	3.458	14.056			
	heart Care building	6	3.708	16.917			
Suggested solution	Surgery building	15	3.564	14.700	1.267	0.531	Not sig.
	Internal Medicine building	9	3.859	18.167			
	heart Care building	6	3.530	13.500			

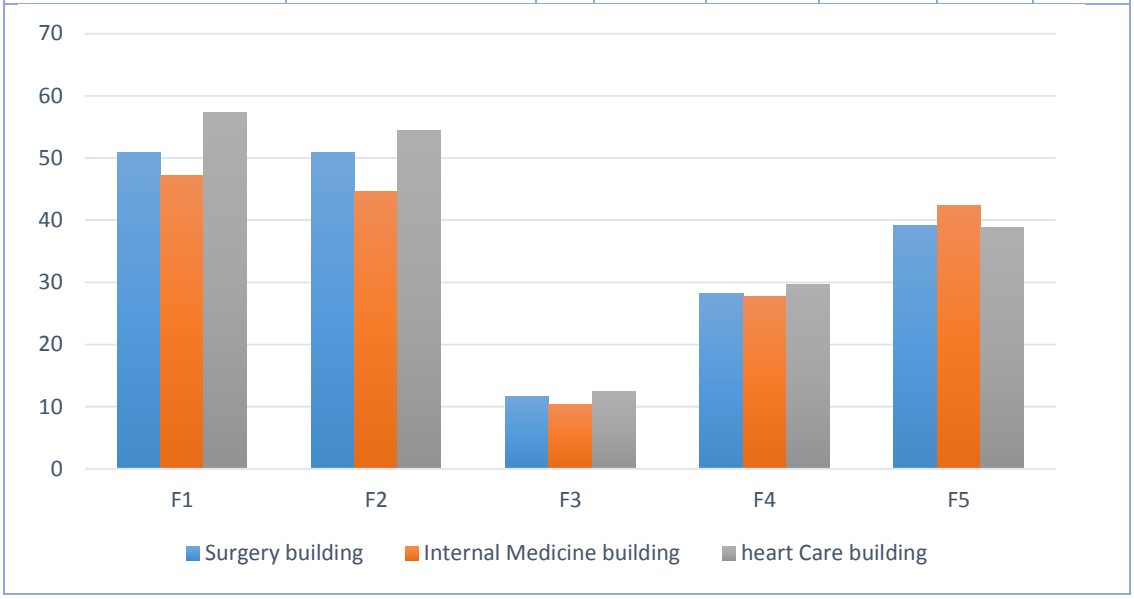


Figure 5.9: Mean of fields of questionnaire according to building

According to Table (5.14) and figure (5.9), there are no statistical significant differences in the first, third, fourth, and fifth fields. These results are attributed to the fact that, there is no difference in the effect of lighting level over patients according to the building and that is because there are enough lighting in the buildings despite the poor lighting in the internal medicine building and the absence of natural lighting. The electricity shortage in Gaza created a feeling that lighting is enough even if the lighting level is bad and unsuitable for carrying out tasks in comparison with the dark homes that have no lighting.

There is no difference according to the building design because all of these buildings were designed in the same way with no difference in lighting sources and all of them use fluorescent lights with identical distribution and shapes.

None of the patients stayed in private rooms. The fourth and fifth fields expresses the desires and preferences of the patients, and they were the same in all of the buildings. So the kind of building have no effect over these fields. In addition, the table shows that there are statistical significant differences in the second field due to building.

To determine direction of the differences in the second field, the researcher used Scheffe test. Table (5.15) shows the results:

Table 5.15Scheffe post Hoc Matrix to identify the direction of differences between the building type in the second field

	Surgery	Internal Medicine	heart Care
	50.800	44.556	54.500
Surgery building 50.800	0		
Internal Medicine building 44.556	6.244	0	
heart Care building 54.500	3.700	*9.944	0

* sig. at (0.05)

Table (5.15) shows that there are statistically significant differences between **heart Care building** and **Internal Medicine building** in favor to heart **Care building**, and there are no differences between other buildings types.

These result are attributed to the fact that, despite the low level of natural lighting in both buildings (Internal Medicine and Heart Care buildings), the number of artificial lighting fixtures is different which affected the general lighting in the rooms. The average lighting fixtures in the Heart Care building is (12) while the number is (4) in the Internal Medicine building.

There is no difference between the surgery and heart care buildings. Because of the natural lighting availability, which compensates for the artificial lighting that the heart care building has.

5.9 Conclusion

This chapter dealt with the results of the study that was applied in surgery, internal medicine and heart care department in Alshifa Hospital to investigate the impact of existed lighting on patients' well-being in their rooms. Additionally, to discuss the patients' lighting preferences in their rooms which provide visual, emotional and biological requirements. In addition, it discusses promotion of healing environment by the fulfilment of quantity and quality lighting design consideration.

This chapter concluded that the satisfaction about existed lighting in studied Al-shifa departments reaches average weight of (50.9%). The quality of lighting design and lighting intensity increases the level of satisfaction with lighting and visual comfort that promotes well-being for patients. Moreover, providing the patients' rooms with dimmed lighting will improve patients' sleeping and produce Melatonin hormone that helps patients' to relax. The integration between artificial and natural lighting is important aspect to promote healing environment and enhance patients' well-being.

Chapter 6

Conclusion and Recommendations

The main findings of the theoretical study are:

- The evidence-based design is important in promoting healing environment and health outcomes that support and stimulate recovery processes.
- The concept of healing environments is not new but recently it started to be applied in the design of healthcare.
- Physical and social environment strategies of the healing environment will promote and improves the patients' well-being.
- Color render (CRI) which describes how alight source makes the color of an object appear to the human eye. Ra ranges from (50-100) in which 90-100 give excellent color rendering, 80-90 give good color rendering, 60_80 give moderate color rendering and < 60 give poor color rendering. And in healthcare for supporting diagnosis and treatment and for good rendition of skin and tissue, a CRI of 80 or higher is recommended.
- Correlated Color temperature (CCT) measures light color appearance. Moreover, according to lighting industry convention, lamps with low CCT values (2700 K to 3000 K) provide light that appears "warm," while lamps having high CCT values (4000 K to 6500 K) provide light that appears "cool".
- Quantity lighting design concern about lighting type and quantity and required information about surface reflectance of walls, ceilings and floors. While quality lighting design concern about relationship and effect of lighting on human reactions.
- The key quality lighting design consideration for healthcare must achieve visual emotional and biological requirements.

- Designing around task importance in the patient room includes general/ambient lighting as well as lighting for direct or cursory observation, critical examination, reading, restroom/ shower illumination, day and night-lighting and lighting control.

- Flexibility in system design should allow ranges in illuminance between 30-2000 lux. And allow the patient to have individual control.

- Light trespass during sleep hours must be controlled to minimize exposure that can alter circadian rhythms. Moreover. Dimmed red-amber light sources appear to positively affect melatonin.

- A Daylit -as new lighting design solution- is a patient room model, which provides good outdoor views and daylighting to increase patient well-being: a psychological state resulting in reduced stress and anxiety, lower blood pressure, improved post-operative recovery, reduced need for pain medication and shorter hospital stays

- HealWell is a new light solution for patient rooms, to improve the healing environment, by supporting patient comfort and staff performance with light that adapts to individual needs. Dynamic shades of warm and cool light support patients' biorhythms during the day

- Lighting have an effect on human well-being by enabling performance of visual tasks, controlling the body's circadian system, affecting mood and perception, facilitating direct absorption for critical chemical reactions within the body.

- The need of light increase as a function of age.

- Visual acuity increases with increasing illuminance.

- Task performance improves with increased light levels.

- Error rates reduce when work-surface light levels are relatively high.

- The body's hormone levels rise and fall with light cycles by a day. Cortisol production increases with morning light and decreases throughout the course of the day. Melatonin levels increase as darkness sets in and decrease as morning approaches.

- The light effect on human biological clock, which is important as it influences many aspects of our physical and emotional well-being.

- Natural and artificial lighting has a beneficial effect on patients' mood and general quality of life.

- The healthcare located in warmer and drier climates had shorter length of stay for patients. While hospitals in colder climates had longest lengths of stay in winter and fall.

- The patients exposed to a higher intensity of sunlight experience less perceived stress, marginally less pain, took 22% less analgesic medication per hour, and had 21% less pain medication costs.

- Dynamic lighting solutions can be applied in hospital spaces with no direct natural light, to make staff feel connected to the outside world. So it is enhance the well-being, motivation and performance by giving them control over their lighting and creating a stimulating lighting ambience (changes in the level and tone of white light) that follows the rhythm of human activity.

The combination of these studies result in these conclusion:

- Al-shifaa departments – surgery, internal medicine and heart care- have the top rated effects of lighting intensity on well-being found for visual effects, which have percent weight (77.8%). Followed by psychological effects with percent weight (62.15%), then biological effects with percent weight (56.2%), which show that lighting design in this department met quantity requirements and ignore quality requirements in lighting design. and this became clear from satisfaction about existed design that reaches percent weight (50.9%).

- The existed lighting design in surgery, internal medicine and heart care departments in Al-shifa' hospital does not follow the design quality consideration, where appropriate lighting was not available for patients sleeping and the controlling method during sleeping.

- The electricity crisis in Gaza creates the feeling of sufficiency and satisfaction on any lighting level, without taking into consideration its efficiency or if it fits with patient well-being, compared with the dark houses that lack electricity.

- Type of existed lighting (Fluorescent) in surgery, internal medicine and heart care departments in Al-shifa' hospital was suitable, whereas Ra= 74, and color of lighting is daylight which fits with patients room, but there is a problem in lighting design, which is represented in the absence of variety in colors of lighting. Which is sometimes needed by patient. In addition, there is no controlling method in colors of lighting.

- Quality of lighting design includes distribution of lighting fixtures, existence of multiple lighting sources inside the patients' rooms. In addition, using layers system in lighting design to be harmonious with patients' requirements and existence task, and accent lighting. The availability of indirect ambient lighting reduces glare on the eye. All of these lead to increase the level of satisfaction with lighting and visual comfort to promote the well-being of the patients.

- Lighting affects the feeling of the place more than affects the emotion of the patient especially feeling the beauty of place and hospitality.

- Good design according to design consideration, which includes design quality that is specialized in type and color of lighting lead to improve the well-being of patients, which increases the level of public satisfaction, visual comfort, improves the feeling of the place, mood, and psychological comfort.

- The better the patients' rooms are lit the more the patients have a sense of satisfaction with regard to the level of illumination in their rooms

- Good design includes the availability of dimmed lights during sleeping time, which increases public satisfaction level about lighting and increases the biological effects on patients' well-being inside the rooms during sleeping, healthy sleeping can help to improve the patients' well-being by helping to secrete the human body melatonin hormone in darkness.

- Lighting design in surgery, internal medicine and heart care in Al-shifa' hospital does not follow the design quality in design consideration in terms of controlling lighting integration.

- Patients prefer natural lighting to artificial lighting.

- Integration between natural and artificial lighting affects the feeling of place more than the emotions of patients' especially feeling beauty of place and hospitality.

- Good design, which includes controlling integration between natural and artificial lighting helps to increase satisfaction of patients about lighting and increase psychological effects on well-being in patients' room.

- Proper lighting design is the first need for the patients in their rooms where multiple light fixtures must be available in the rooms, light sources must follow quality and quantity criteria of lighting design so it can increase the public satisfaction about lighting and its effects in well-being.

- Patients' need to control the lighting intensity according to their psychological states and mood that supply them with psychological and biological comfort that promote their well-being

- Presence of multiple colored lighting and letting the patient use them freely and to choose the appropriate color can improves his/her well-being.

- Presence of quantity and quality criteria of lighting intensity and choosing of the color and type helps the patients' to get comfortable rest that can increase the biological comfort and makes them get well fast.

- Patients' need to control the integration between natural and artificial lighting, increase the design efficiency and increases the psychological comfort of the patient.

6.1 Recommendation

- Making a lot of similar studies related to study problem and impact of lighting on patients' well-being.

- Design the lighting according to the standards carefully, which include high quality and high implementation.

- Improvement of healing environment by taking into consideration lighting design according to applicable standards in healthcare facilities.

- Interested people and decision maker must develop a special code about lighting design in healthcare facilities because of its impact on well-being.
- Raise the awareness about the importance of lighting and its impact on well-being.
- Cooperation between architects, electrical engineers and interior designers to develop the most appropriate solution and suggestion for lighting design within applicable quality standards.
- Availability of natural and artificial lighting, and the integration between them in architectural design for healthcare facilities which have good impact on patients' well-being,
- Kinds of appropriate lighting should be available in healthcare facilities.
- Using high quality lighting types with high Ra in healthcare facilities.
- Using color temperature (CT) of lighting similar to daylight such as neutral white.
- Using modern techniques in lighting such as dynamic lighting, heal-well, day-lit.
- Using lighting that include automatic control in healthcare facilities.
- Using several illumination for the patients' that serve every patient individually, and must provide bedside lighting fixtures, high intensity lighting above patients' beds, and patient control of these lighting.
- Providing dimmed lights for patients' at sleeping time.
- Lighting design must follow layers lighting design to provide a variation of lighting.
- Using techniques of controlling lighting intensity and color.
- Providing lighting fixtures with different and attractive shapes to make the patients feel like they are in their homes.
- Similarity between internal and external lighting to stimulate the production of the hormone which helps the patients' to sleep well.

References

AACN. (2007). AACN Protocols for Practice Creating Healing Environment (2nd ed.). California: AACN: American Association of Critical-care Nurses. Retrieved from http://www.aacn.org/

AIA. (2006). Guidelines for Design and Construction of Hospital and Health Care Facilities. Washington: AIA: The American Institute of Architects Press.

Alcaraz, M. (2009, 9 1). Retrieved from http://www.buildings.com/: http://www.buildings.com/article-details/articleid/8804/title/lighting-the-way-to-good-healthcare-design.aspx

ALG. (2010, 10 30). Advance Lighting Guidelines. Retrieved from http://www.algonline.org/index.php?lighting-quality#top

Ampt, A., Harris, P., & Maxwell, M. (2008). The Health Impacts of the Design of Hospital Facilities on Patient Recovery and Wellbeing, and Staff Wellbeing: A Review of the Literature. Australia: 2008 UNSW Research Centre for Primary Health Care and Equity. Retrieved from www.cphce.unsw.edu.au

Aripin, S. (2007). 'Healing Architecture': Daylighting Hospital Design. Conference on Sustainable Building South East Asia (pp. 173-174). Malaysia: Conference on Sustainable Building South East Asia.

Barkmann, C., Wessolowski, N., and Schulte-Markwort, M, (2011). Applicability and efficacy of variable light in schools, Physiology and Behavior, Sept. 2011.

Begemann, S. H. A., van den Beld, G. J., & Tenner, A. D. (1997). Daylight, artificial light and people in an office environment: Overview of visual and biological responses. International Journal of Industrial Ergonomics, 20(3), p: 231–239.

Bellman, W. F. (2001). Lighting The Stage: Art and Practice (3 ed.). Lousiville: Broadway Press.

Boyce, Peter (2009). The impact of light in buildings on human health, SHB2009 – 2nd International Conference on Sustainable Healthy Buildings, Seoul, Korea

Boyce, P. R. (2006). Lighting quality and office work: two field simulation experiments, Lighting Res Techn 2006, 38(3), p: 191–233.

Boyce, P. R. (2006). Education: the key to the future of lighting practice, Lighting Res Techn 2006, 38(4), p: 283–294.

Boyce , P., Hunter, C., & Howlett , O. (2003). The benefits of daylight through windows. California: Troy, NY: Rensselaer Polytechnic Institute.

Brown, G., Kline, J., Livingston, G., McDonald, B., Smith, C., Wilkerson, M., . . . Staczek, D. (2005). DAYLIGHTING HOSPITAL PATIENT ROOMS. Eugene: University of Oregon & Zimmer Gunsel Frasca Architects, LLP.

Buckle, J. (2001). Aromatherapy and diabetes. Diabetes Spectrum, 14(3), 124–126.

Chia, D. (2003, 2 25). Retrieved from wikipedia.org: http://en.wikipedia.org/wiki/Lighting

cndlighting. (2012, 11 8). Retrieved from http://www.cndlighting.com/: http://www.cndlighting.com/index.php/news/show?id=23

Cooper Lighting. (2014). In Healthcare Solutions. Retrieved from www.cooperhealthcaresolutions.com

Derksen, B. (2001, 11 1). wikipedia.org. Retrieved from http://en.wikipedia.org/wiki/Color

DiLaura, D., Houser, K., Mistrick, R., & Steffy, G. (2011). Lighting Handbook (10th ed.). Pennsylvania: IES - Illuminating Engineering Society .

Edwards, L., & Torcellini, P. (2002). A Literature Review of the Effects of Natural Light on Building Occupants. NREL: National Renewable Energy Laboratory, U.S. Department of Energy Laboratory. Colorado: NREL. Retrieved from http://www.osti.gov/bridge

electrical-knowhow. (2012, 3). Retrieved from http://www.electrical-knowhow.com/2012/03/indoor-lighting-fixtures.html

electrical-knowhow. (2012, 3). Retrieved from http://www.electrical-knowhow.com/2012/03/electrical-load-classification-and_10.html

European Commission. (2012, 3 19). Health Effects of Artificial Light. SCENIHR: Scientific Committee on Emerging and Newly Identified Health Risks, p. 18.

FIES, G. G. (2003). Interior Lighting for Designers (4 ed.). New Jersey: John Wiley & Sons, Inc.

Hamilton , K. D. (2006). Four Levels of Evidence-Based Practice. Washington: AIA Journal of Architecture.

Harrell, J. W., FAIA, FACHA, & LEED AP. (2012). Daylighting in Healthcare. AIA OHIO 2012 Convention American College of Healthcare Architects Series (pp. 6-7). Washington: AIA: The American Institute of Architects Press.

Hagen, Mark, Galetzka, Mirjam, Pruyn, Ad, & Peters, Joyce (2009). Effects of Colour and Light on Customer Experience and Time Perception at a virtual Railway Station, Experiencing Lighting 2009: International Conference on the Effects of Light on Wellbeing, Eindhoven University of Technology, Eindhoven, the Netherlands, p: 26-27 October 2009

Joseph, A. (2006). The Impact of Light on Outcomes in Healthcare Settings. Concord: The Center for Health Design.

Kamali, N., & Abbas, M. (2012). Healing Environment: Enhancing Nurses' Performance through Proper Lighting Design. AicE-Bs 2011 Famagusta Asia Pacific International Conference on Environment-Behaviour Studies (pp. 205 – 212). Famagusta: Procedia. Retrieved from www.sciencedirect.com

Kaplow, R., & Hardin, S. R. (2007). Critical Care Nursing: Synergy for Optimal Outcomes. (1st, Ed.) The United State Of America: Jones & Bartlett Learning.

Karlen, M., Benya, J. R., & Spangler, C. (2012). Lighting Design Basics (2nd ed.). New Jersey: Wiley and Sons.

Kellert, S., Heerwagen, J., & Mador, M. (2008). Biophilic Design: The Theory, Science and Practice of Bringing Buildings to Life. (1st, Ed.) New Jersey: John Wiley & Sons. Retrieved from https://books.google.ps/books

Kronqvist, A. (2010). The Influence of the Lighting Environment on Performance and Well-Being in Offices, Colour and Light in Architecture_First International Conference 2010_Proceedings, as part of a PhD thesis sponsored by "Bertiloch Britt Svenssonsstiftelse" under the su-pervision of Maria Johansson, assoc. Professor, University of Lund, Sweden.

Kort, Yvonne, & Smolders, Karin (2009). Effects of Dynamic Lighting on Office Workers: First-year Results of a Longitudinal Field Study, EXPERIENCING LIGHT 2009: International Conference on the Effects of Light on Wellbeing, Eindhoven University of Technology, Eindhoven, the Netherlands, p: 26-27 October 2009

Lighting Research Center. (2004, 10). NLPIP. lighting sources and color, 8(1). Retrieved from http://www.lrc.rpi.edu/programs/nlpip/lightinganswers/lightsources/whatisCCT.asp#

LuxMeter. (2012, 5 17). iosnoops.com. Retrieved from http://www.iosnoops.com/appinfo/luxmeter-for-iphone-and-ipad/526675593

Mattsson, Mats-Olof, Jung, Thomas, &Proykova, Ana (2012). Health Effects of Artificial Light: Scientific Committee on Emerging and Newly Identified Health Risks SCENIHR , European Union

Majoros, A., & Habil, D. (2011). ARTIFICIAL LIGHTING. Budapest: University of Technology and Economics. Retrieved from www.egt.bme.hu

Malkin, J. (2003). The Business Case for Creating a Healing Environment. Concord: The Center for Health Design.

Malkin, J. (2008). A Visual Reference for Evidence-Based Design. California: The Center for Health Design.

McMullough, C. (2010). EVIDENCE-BASED DESIGN FOR HEALTHCARE FACILITIES. Indianapolis: Renee Wilmeth.

Ministry of Health - Palestinian Health Information Centre, Annual Health Report - Palestine 2010, April 2011, Available at: http://www.moh.ps/attach/441.pdf

Nightingale, F. (1859). Notes on Nursing. doi:https://books.google.ps/books

Nightingale, F. (1860). Notes on Hospitals. doi:https://books.google.ps/books

Osram Sylvania. (2013). Retrieved from www.sylvania.com: https://www.sylvania.com/en-us/applications/healthcare/Pages/lighting-design-goals.aspx

Palestinian Ministry of Health. (2012, 3 31). www.moh.gov.ps/shifa. Retrieved from http://www.moh.gov.ps/shifa/index.php?option=com_content&view=article&id=6&Itemid=4

Pawson, R. (2006). Evidence-based Policy: A Realistic Perspective. New York : Sage Publications.

Petterson, M. (2000). Reduced noise levels in ICU promote rest and healing. Critical Care Nurse, 20(5), 104.

Philips. (2011a). HealWell - A new lighting solution for patient rooms. Netherlands: 2011 Koninklijke Philips Electronics N.V.

Philips. (2011b). HealWell - A new lighting solution for patient rooms. Netherlands: Koninklijke Philips Electronics N.V. Retrieved from www.philips.com

Philips. (2014). Designing people-centric hospitals using Philips lighting solutions. Netherlands: Koninklijke Philips N.V. Retrieved from www.philips.com/healthcarelighting

Philips Lighting Academy. (2008). Basics of light and lighting. Amsterdam: Philips Lighting Academy.

Phillips, D. (2004). Daylighting: Natural Light in Architecture. London: British Library Cataloguing in Publication Data.

Riegens lighting. (2013). riegens.com. Retrieved from http://riegens.com/catalog/dynamic-lighting

Sant, Maartje (2013). Exploring the effect of colored light on psychiatric patients, Master Thesis, Eindhoven University of Technology (TU/e), Netherlands.

Schlangen, L. (2010). The role of lighting in promoting well-being and recovery within healthcare. Amsterdam: Koninklijke Philips Electronics N.V.

SCHWEITZER, M., GILPIN, L., & FRAMPTON, S. (2004). Healing Spaces: Elements of Environmental Design That Make an Impact on Health. THE JOURNAL OF ALTERNATIVE AND COMPLEMENTARY MEDICINE, 10, S-71_S-83.

Shamsul, B.M.T, Sia, C.C., Ng, Y.G, &Karmegan, K. (2013) Effects of Light's Colour Temperatures on Visual Comfort Level, Task Performances, and Alertness among Students, American Journal of Public Health Research, Vol. 1, No. 7, p: 159-165. Available online at http://pubs.sciepub.com/ajphr/1/7/3

Shikder, S. H., Mourshed, M., & Price, A. D. (2010). Optimisation of a daylight-window: hospital patient room as a test. In W. Tizani (Ed.), icccbe: International Conference on Computing in Civil and Building Engineering. Nottingham: Nottingham University Press.

Smith, K., Firth, K., Ananth, S., & Reece, B. F. (2009). Environmental Scan. Samueli Institute Nursing Forum on Optimal Healing Environments (pp. 2-3). Alexandria: Samueli Institute.

Stangor, C. (2011). Beginning Psychology. Maryland: saylor.org. Retrieved from http://www.saylor.org/books/

Steer, W. A. (2008, 3 15). Retrieved from http://www.techmind.org/:http://www.techmind.org/colour/index.html

Topf, M., Bookman, M., & Arand, D. (1996). Effects of critical care unit. Journal of Advanced Nursing, 24, 545–551.

Ulrich, R. (1984). View through a window may influence recovery from. Science, 224(4647), 420–421.

Ulrich, R., & Zimring, C. (2004). The role of the physical environment in. Concord: The Center of Health Design for designing the 21st Century Hospital Project. Retrieved from www.healthdesign.org/research/reports/pdfs/role_physical_env

Ulrich, R., Zimring, C., Zhu, X., Dubose, J., Seo, H., Choi, Y., . . . Joseph, A. (spring 2008). Review Of The Research Literature On Evidence-Based Healthcare Design. HERD (Health Environments Research and Design Journal), 1(3). Retrieved from https://www.healthdesign.org/chd/research/review-research-literature-evidence-based-healthcare-design

Ulrich, R. S., Zimring, C., Joseph, A., Quan, X., &Choudhary, R. (2004). The role of the physical environment in the hospital of the 21st century: A once-in-a-lifetime opportunity. Concord, CA: The Center for Health Design.

Unwin, Jemima (2010). Night Lighting in Hospitals – and its Impact on Staff and Patients, Master Thesis, Bartlett School of Architecture, London.

Joseph, Anjali (2006). The Impact of Light on Outcomes in Healthcare Settings: The Center for Health Design, Concord, California

WHO World Health Organisation. (2015). http://www.who.int/. Retrieved from http://www.who.int/topics/health_systems/en/

Healing_environments. (2015). In wikipedia. Retrieved May 24, 2005, from http://en.wikipedia.org/wiki/Healing_environments

Evidence-based_design#Method. (2015). In wikipedia. Retrieved May 24, 2005, from http://en.wikipedia.org/wiki/Evidence-based_design#Method

Young, C., & Koopsen, C. (2009). Spirituality, Health, and Healing: An Integrative Approah Book. Burlington: Jones & Bartlett Publishers.

Zimring, C., Augenbroe, G., Malone, E., & Sadler, B. (2008). Implementing Healthcare Excellence: The Vital Role Of The CEO In Evidence-Based Design. California: The Center for Health Design and Georgia Institute of Technology College of Architecture. Retrieved from https://www.healthdesign.org/chd/research/implementing-healthcare-excellence-vital-role-ceo-evidence-based-design

Zumtobel Lighting. (2013). The Lighting Handbook (4 ed.). Dornbirn: Zumtobel Lighting.

The Palestinian National Authority
Ministry of Health
Directorate General of Human Resources Development

السلطة الوطنية الفلسطينية
وزارة الصحة
الإدارة العامة لتنمية القوى البشرية

الرقم: ..... التاريخ: 2015/04/22م

الأخ / د. عبد اللطيف الحاج
مدير عام المستشفيات

المحترم،،،

السلام عليكم ورحمة الله وبركاته،،،

الموضوع/ تسهيل مهمة باحث

بخصوص الموضوع أعلاه، يرجى تسهيل مهمة الباحث/ صفاء عبد اللطيف الحاج الملتحقة ببرنامج ماجستير الهندسة المعمارية – كلية الهندسة – الجامعة الإسلامية بغزة في إجراء بحث بعنوان :-

" تأثير الإضاءة في المستشفيات على صحة المرضى "

حيث الباحثة بحاجة لتعبئة استبانه من عدد من المرضى المنومين في مجمع الشفاء الطبي، وذلك بما لا يتعارض مع مصلحة العمل وضمن أخلاقيات البحث العلمي، و دون تحمل الوزارة أي أعباء او مسئولية.

وتفضلوا بقبول التحية والتقدير،،،

د. ناصر رأفت أبو شعبان
مدير عام تنمية القوى البشرية

صورة/
- الإدارة العامة للرقابة الداخلية
- صاحب/ـة العلاقة

The Palestinian National Authority
Ministry of Health
Directorate General of Human Resources Development

السلطة الوطنية الفلسطينية
وزارة الصحة
الإدارة العامة لتنمية القوى البشرية

الرقم :..... التاريخ: 2015/05/20م

الأخ / م. بسام الحمدين المحترم،،،
مدير عام الهندسة والصيانة

السلام عليكم ورحمة الله وبركاته،،،

الموضوع/ تسهيل مهمة باحث

بخصوص الموضوع أعلاه، يرجى تسهيل مهمة الباحث/ **صفاء عواد حبيب** الملتحقة ببرنامج ماجستير الهندسة المعمارية - كلية الهندسة - الجامعة الإسلامية بغزة في إجراء بحث بعنوان :-

" تأثير الإضاءة في المستشفيات على صحة المرضى "

حيث الباحثة بحاجة للخرائط الخاصة بمجمع الشفاء الطبي، وذلك بما لا يتعارض مع مصلحة العمل وضمن أخلاقيات البحث العلمي، و دون تحمل الوزارة أي أعباء أو مسئولية.

وتفضلوا بقبول التحية والتقدير،،،

د. ناصر رأفت أبو شعبان
مدير عام تنمية القوى البشرية

صورة/
- الإدارة العامة للرقابة الداخلية
- صاحب/ـة العلاقة

Gaza Tel / 08-2827298 Fax / 08-2868109 Email / hrd@moh.gov.ps

Questionnaire in Arabic language

بسم الله الرحمن الرحيم

الجامعـــــة الإسلاميـــــة_غـــــزة
شؤون البحث العلمي والدراسات العليا
كليـــــــــــة الهـندســـــــــــة
قســـــم الهنـدســـــة المعمـاريـــة

أخي المريض / أختي المريضة

السلام عليكم ورحمة الله وبركاته **أما بعد...**

بين يديك استبانة لجمع المعلومات حول دراسة بعنوان " تأثير الإضاءة على صحة المرضى " . وللمساعدة في إتمام هذه الدراسة برجاء التكرم بقراءة عبارات الاستبانة قراءة متأنية ومن ثم إبداء رأيكم بوضع علامة (√) في المربع الذي يناسب رأيك. علماً بأن البيانات التي سيتم جمعها ستستخدم لأغراض البحث العلمي فقط، وبارك الله فيكم.

وتفضلوا بقبول وافر شكري وتقديري...

الباحثة

م. صفاء عواد حبيب

خاص بالباحثة				
شدة الاضاءة:	**( ) أقل من 250**	**250( ) -800**	**( ) أكثر من 800**	
المبنى	**( ) الجراحة**	**( ) الباطنة**	**( ) عناية القلب**	
توجيه الغرفة	**( ) شرقي**	**( ) غربي**	**( ) شمالي**	**( ) جنوبي**

أولاً: البيانات الشخصية :

يرجى الإجابة عن الأسئلة التالية:

1	الجنس	( ) ذكر	( )أنثى	
2	العمر	( ) 16-29	( ) 30-39	( ) ≥40
3	عدد أيام المبيت في الغرفة	( )0	( ) 1-9	( ) ≥10

ثانياً: فقرات الاستبانة:

1. المجال الأول: تأثير مستوى الإضاءة على صحة المريض (بصرياً وبيولوجياً ونفسياً)

الرجاء الإجابة باستخدام المقياس أدناه عن طريق وضع علامة (√) في المربع الذي ينطبق عليه رأيك:

		موافق بشدة	موافق	محايد	غير موافق	غيرموافق بشدة
1.1	**مستوى الإضاءة كافي لأداء المهام التالية:** ○ **الرؤية**					
1.2	○ **القراءة**					
1.3	○ **الانتقال**					
1.4	○ **الأكل**					
1.5	**عدد مصادر الإضاءة كافي.**					
1.6	**أشكال ووحدات الإضاءة جميلة وجذابة.**					
1.7	**التعدد في وحدات الإضاءة المستخدمة جيد.**					
1.8	**هناك اضاءات غير مرغوبة منعكسة من بعض الاسطح في الغرفة.**					
1.9	**الإضاءة الموجودة تسبب حساسية في العينين.**					
1.10	**مستوى الإضاءة الموجود يسبب اجهاد في العينين.**					
1.11	**مستوى الإضاءة الموجود يشعرك بـــ:** ○ **الراحة**					
1.12	○ **الحيوية والنشاط**					

1.13	○ النعاس والخمول					
1.14	○ التوتر					
1.15	مستوى الإضاءة غير كاف في بعض الأوقات.					
1.16	يمكن التحكم بشدة الإضاءة في الغرفة.					
2. المجال الثاني: تأثير لون ودرجة حرارة الإضاءة على صحة المريض (بصرياً و بيولوجياً ونفسياً)						
		موافق بشدة	موافق	محايد	غير موافق	غيرموافق بشدة
2.1	لون الإضاءة مناسب لرؤية الأشياء بوضوح.					
2.2	لون الإضاءة مناسب لرؤية الألوان بألوانها الحقيقية.					
2.3	لون ودرجة حرارة الإضاءة الموجودة يشعرك ب: الحيوية والنشاط					
2.4	○ الهدوء والاسترخاء					
2.5	○ اليقظة والتنبه					
2.6	○ البهجة والسرور					
2.7	○ القلق والاضطراب					
2.8	يتلاءم لون الإضاءة مع ألوان الغرفة.					
2.9	ألوان الإضاءة الموجودة تحقق الإحساس /الشعور بـ: ○ الراحة في المكان					
2.10	○ جمال المكان					
2.11	○ رسمية المكان					
2.12	○ أمان المكان					
2.13	○ دفء المكان					

2.14	يمكن التحكم بألوان الإضاءة في الغرفة.					
2.15	التحكم بألوان الإضاءة يحقق الراحة.					
3. المجال الثالث: تأثير الإضاءة على نوم المرضى						
		موافق بشدة	موافق	محايد	غير موافق	غيرموافق بشدة
3.1	أستطيع النوم في الإضاءة الحالية.					
3.2	أشعر براحة أكثر عندما تكون الإضاءة خافتة.					
3.3	أشعر براحة خلال النوم في وجود الإضاءة الحالية.					
3.4	يمكن التحكم بلون الإضاءة وقت النوم.					
4.المجال الرابع: تأثير التكامل بين الإضاءة الطبيعية والصناعية على صحة المريض (بصرياً و بيولوجياً ونفسياً)						
		موافق بشدة	موافق	محايد	غير موافق	غيرموافق بشدة
4.1	مستوى الاضاءة الصناعية يتغير بشكل مناسب مع مستوى الاضاءة الطبيعية طوال النهار.					
4.2	لون الإضاءة الصناعية متكامل مع ألوان الإضاءة الطبيعية خلال النهار.					
4.3	التكامل بين الإضاءة الطبيعية والصناعية يشعرك بـ: • الحيوية والنشاط					
4.4	• الراحة					
4.5	• الهدوء والاسترخاء					
4.6	التكامل بين الإضاءة الطبيعية والصناعية يشعرك بـ: • جمال المكان					

4.7	• أمان المكان					
4.8	• رسمية المكان					
5. المجال الخامس: الحلول المقترحة						
		موافق بشدة	موافق	محايد	غير موافق	غيرموافق بشدة
5.1	أفضل تغير شدة الإضاءة أوتوماتيكياً خلال اليوم.					
5.2	أفضل تعدد ألوان الإضاءة في الغرفة.					
5.3	أفضل التحكم بألوان الإضاءة في الغرفة.					
5.4	أفضل تغيير ألوان الإضاءة أوتوماتيكيا خلال اليوم.					
5.5	أفضل إطفاء الأضواء وقت النوم.					
5.6	أفضل تغير لون الإضاءة وقت النوم.					
5.7	أفضل التنوع في توزيع الإضاءة في الغرفة.					
5.8	أفضل التنوع في أشكال وحدات الإضاءة في الغرفة.					
5.9	أفضل التكامل بين الإضاءة الطبيعية والصناعية.					
5.10	أفضل التحكم بالتكامل بين الإضاءة الطبيعة والصناعية.					
5.11	أفضل الإضاءة الصناعية على الطبيعية.					

Appendix 3

Table(1): Mann Whitney Test results: Average grades and ranks and the total value (U) and value (Z) and to get to know the level of difference between Male and female									
field	**Gender**	**N**	**Mean**	**Mean Rank**	**Sum of Ranks**	**Mann Whitney U**	**Z**	**Sig. value**	**Sig. level**
Effects of lighting level on patients' health (Visual, Biological, Psychological)	**Male**	16	49.375	13.844	221.5	85.500	1.105	0.269	Not sig.
	female	14	52.929	17.393	243.5				
Effects of color and temperature of lighting on the patients' health	**Male**	16	49.750	15.688	251.0	109.000	0.125	0.901	Not sig.
	female	14	49.571	15.286	214.0				
Effects of lighting on patients' sleeping	**Male**	16	11.000	13.438	215.0	79.000	1.402	0.161	Not sig.
	female	14	11.929	17.857	250.0				
Effects of integration between natural light and artificial light on patients' health (Visual, Biological, Psychological).	**Male**	16	28.375	15.031	240.5	104.500	0.313	0.754	Not sig.
	female	14	28.286	16.036	224.5				
Suggested solution	**Male**	16	38.813	13.781	220.5	84.500	1.147	0.251	Not sig.
	female	14	41.571	17.464	244.5				

Table (2): Kruskal-Wallis Test results							
Field	age	N	Mean	Mean Rank	Chi-Square	Sig. value	Sig. level
Effects of lighting level on patients' health (Visual, Biological, Psychological)	16-29	11	50.818	14.909	0.084	0.959	Not sig.
	30-39	5	51.400	15.600			
	40 ≤	14	51.071	15.929			
Effects of color and temperature of lighting on the patients' health	16-29	11	47.909	12.500	2.391	0.302	Not sig.
	30-39	5	48.800	15.200			
	40 ≤	14	51.357	17.964			
Effects of lighting on patients' sleeping	16-29	11	11.000	15.455	0.031	0.985	Not sig.
	30-39	5	11.800	16.100			
	40 ≤	14	11.643	15.321			
Effects of integration between natural light and artificial light on patients' health (Visual,	16-29	11	27.000	14.091	0.619	0.734	Not sig.
	30-39	5	29.800	17.700			
	40 ≤	14	28.857	15.821			

Biological, Psychological).							
Suggested solution	16-29	11	42.182	18.091	1.546	0.462	Not sig.
	30-39	5	40.000	14.600			
	40 ≤	14	38.500	13.786			

Table(3): Mann Whitney Test results: Average grades and ranks and the total value (U) and value (Z) and to get to know the level of difference between Male and female

Field	Rest days in room	N	Mean	Mean Rank	Sum of Ranks	Mann Whitney U	Z	Sig. value	Sig. level
Effects of lighting level on patients' health (Visual, Biological, Psychological)	1-9	22	50.455	14.614	321.500	68.500	0.918	0.359	Not sig.
	More than 10	8	52.625	17.938	143.500				
Effects of color and temperature of lighting on the patients' health	1-9	22	48.682	14.045	309.000	56.000	1.504	0.133	Not sig.
	More than 10	8	52.375	19.500	156.000				
Effects of lighting on patients' sleeping	1-9	22	11.000	14.114	310.500	57.500	1.462	0.144	Not sig.
	More than 10	8	12.625	19.313	154.500				
Effects of integration between natural light and artificial light on patients' health (Visual, Biological, Psychological).	1-9	22	28.000	14.727	324.000	71.000	0.801	0.423	Not sig.
	More than 10	8	29.250	17.625	141.000				
Suggested solution	1-9	22	41.227	16.886	371.500	57.500	1.435	0.151	Not sig.
	More than 10	8	37.000	11.688	93.500				

Table (4): Kruskal-Wallis Test results

Field	Orientation	N	Mean	Mean Rank	Chi-Square	Sig. value	Sig. level
Effects of lighting level on patients' health (Visual, Biological, Psychological)	**east**	10	50.900	15.100	2.930	0.402	Not sig.
	west	9	53.667	19.111			
	north	2	46.500	9.250			
	south	9	49.556	13.722			
Effects of color and temperature of lighting on the patients' health	**east**	10	52.100	18.650	7.588	0.055	Not sig.
	west	9	52.333	18.833			
	north	2	42.000	5.750			
	south	9	46.000	10.833			

Effects of lighting on patient' sleeping	**east**	10	11.800	16.550	1.669	0.644	Not sig.
	west	9	12.333	17.500			
	north	2	10.000	14.000			
	south	9	10.444	12.667			
Effects of integration between natural light and artificial light on patients' health (Visual, Biological, Psychological).	**east**	10	28.900	16.450	3.660	0.301	Not sig.
	west	9	29.333	16.944			
	north	2	22.000	4.250			
	south	9	28.111	15.500			
Suggested solution	**east**	10	38.900	14.150	5.104	0.164	Not sig.
	west	9	38.111	12.111			
	north	2	38.500	13.250			
	south	9	43.778	20.889			