Colour Sustainability in Hospitals Interior Spaces

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Abstract

Colour selection is one of the key areas of interior design. Colouring is an art that has its aesthetic moods, criteria and applications, in addition to its different contrasting functions. At the same time, colour has its pure scientific origins and rules that is closely linked to light. The quality of the visual environment has a positive effect on the occupant’s feeling of well-being and in the case of hospitals and healthcare buildings; this can affect staff performance and patient recovery. The paper aims to analyse the sustainability of the colours in the interior spaces of hospitals and improve the performance of the interior spaces of hospitals in line with the humanitarian needs of the user.

The cost of hospital staff and patient treatment is considerable; therefore, measures to maximize performance through improved environments and saving energy by using sustainable colours will generally be cost-effective for these reasons, it is essential to consider lighting and colour design at the early stages of specifying and designing a building. Colour can play a major role in creating sustainable environments. An Applied study using software to create colour criteria when designing interior space elements to maximize the daylight factor which is effecting in patient physiology performance. With respect to the sustainability dimension, the research addressed the relationship between the design of interior space colours and day lighting of hospitals and the users’ psychological and physiological aspects to serve adult people.

1. Introduction

Well-designed, ambient environments will have transitions of lighting and colour design to allow the eye to adapt to changes in lighting levels.

Sometimes a relatively minor change to the colour design or lighting of spaces can solve an on-going, apparently insurmountable, problem (for example, extra lighting on walls with accent colour to brighten up a gloomy area). Colour design and lighting consultants can often pinpoint the reason why a place does not “feel” right. For example, a change of wall or floor colour from light to dark or vice-versa can affect a whole area dramatically and may suggesting appropriate solutions.

For the healthcare industry, the issue of environmental impact is especially paramount. The profession is committed to doing no harm, yet many issues related to the design and operation of healthcare facilities contradict this principle tenet [1].

1.1. The main objective of the research

The research aims to analyse the sustainability of the colours in the interior spaces of hospitals and improve the performance of the interior spaces of hospitals in line with the humanitarian needs of the user, psychological, and the provision of energy.

This is achieved through the following objectives:

- Study the methodology of sustaining colour in the field of interior design.
- Study of the application of modern technologies in the standard software of the relationship between color, light, and positive energy.
- The extent of the impact of the humanitarian needs of the patient and psychological interior design.
- Examine the impact of color performance of elements of the interior spaces to improve the provision of energy.

1.2. Methodology

Approach to the analysis and applied study:

- Analytical and theoretical study to apply, disseminate and utilize in the design of interior spaces colorimetric hospitals.
- Tools rely on the survey study within application of specialized programs Ecotict.

2. Philosophies of healing and interior environment

Historians report that healing was a highly developed art in Atlantis (9500 B.C.) with three different schools of thought on the treatment of illness. Some healers used spiritual methods (flower essences, crystals, and colour therapies); priests used homeopathy, an integration of spiritual and scientific methods; and the allopathic healers used herbs, drugs, and surgical treatments similar to practices used by today’s orthodox physicians (Gerber 1988). As new views evolve about the relationship between stress and illness and about the influence of positive attitudes on healing, more emphasis will be placed on design of the patient care environment [2].

2.1. Hospital users and sustaining environment

Hospital design needs to reflect the wide range of their users, whether patients, visitors or staff. For patients and visitors, entering a hospital is often a stressful and uncertain time. To meet their needs, the strategy is to provide flexibility in services and to adopt a patient-oriented attitude towards improving the hospital environment [3].

A UK study on improvements in patient recovery found that patients were released one-and-a-half days earlier in a refurbished environment compared with an unchanged one. A USA research project established eight consistent themes in what patients and their families look for in the hospital’s built environment, they wanted an environment that [4]:

- Facilitates connection to staff and facilitates connection to the outside world. This included an indoor environment that revealed sights and scenes from nature.
- Conducive to a sense of well-being; that is “homely” (particularly in long-term care),

“attractive”, “inviting”, “cheerful”, relaxing, with positive distractions in waiting areas and an environment that facilitates autonomy and independence.

- Convenient and accessible—clear signs, and easy way finding were important (Figure 1).

For patients and visitors, colour and lighting design can bring a welcome distraction from the problems that have resulted in hospitalization. This can be accomplished with a careful selection of details such as décor, landmarks, artwork, colour, the skills of interior landscape gardening and window designs [5].

2.2. The built environment’s impact on human health

This problem is magnified in healthcare facilities, which often include spaces harmful materials as building materials and finishes that cover floors, walls, ceilings, and the furniture upon which patients are examined, sit, and sleep. Building occupants are exposed to these chemicals through touching chemically contaminated building and furniture surfaces and through exposure to the chemical concentrations in the indoor air. When it comes to the indoor environment of healthcare facilities, physicians are primarily concerned about infection control, especially because weakened immune systems [6].

3. Sustainable healthcare design

In the short term, sustainable healthcare design seeks to address the multitude of issues that contribute to the built environment’s negative impact on human health. The long-term goal is for buildings to be restorative, contributing positively to the physical, emotional, and even spiritual well-being of occupants. By reducing
environmental impacts such as daylight performance, healthcare facilities also reduce environmental contaminants.

This reduction, in turn, helps decrease the potential for negative health impacts to the surrounding community as the result of toxic waste disposal and incineration, which release these contaminants into the soil and air. An examination of the specific benefits sustainable design offers to a healthcare facility and its occupants shows that many are inextricably intertwined. They include improved patient outcomes, improved patient and staff safety, improved patient and staff satisfaction, better community image and loyalty, greater cost savings, and increased productivity. As an increasing number of sustainable design strategies are introduced in healthcare facilities, a corresponding body of evidence grows to support the idea that green building practices translate into improved patient outcomes.

3.1. Sustainable design elements and strategies

Sustainability is measured in all kinds of ways in our life. In the energy we save and the water we conserve. Moreover, in how financially responsible we are as an employer, manufacturer, and service provider. Therefore, we set goals and assess our progress in six key areas: economics, the environment, labour, human rights, society and product responsibility.

A number of critical elements contribute to a sustainable healthcare facility. Indoor air quality, colour, materials and resources, day lighting strategies, connections to nature, cleaning practices, and food service are among them and are discussed in more detail in the following sections.

The design, construction, and operations of buildings, in general, use an enormous amount of materials that generate significant by-products and waste. When designing a facility, considering the type of materials and resources that can reduce the impact of the materials’ life cycle is essential – Figure 2 [6]. Common criteria for selecting finishes for a facility, aesthetics, durability, and maintenance, product’s life cycle, it will have on the environment and people over its useful life. Though a true life cycle analysis of all materials is difficult, some material issues should not be overlooked, such as the impact of materials on indoor air and durability of materials.

3.2. Benefits of sustainable healthcare design

In the short term, sustainable healthcare design seeks to address the multitude of issues that contribute to the built environment’s negative impact on human health. The long-term goal is for buildings to be restorative, contributing positively to the physical, emotional, and even spiritual well-being of occupants. By reducing environmental impacts, healthcare facilities also reduce environmental contaminants. This reduction, in turn,
helps decrease the potential for negative health impacts to the surrounding community. As an increasing number of sustainable design strategies are introduced in healthcare facilities, a corresponding body of evidence grows to support the idea that green building practices, specially clear daylight effect, translate into improved patient outcomes.

These effects have been shown to be related to such issues as improved indoor air quality, a connection to the natural environment, access to sunlight and views. Color does, of course, also have a practical and functional use in patients’ accommodation.

3.3. Physical design elements

The design, construction, and operations of buildings, in general, use an enormous amount of materials that generate significant by-products and waste. When designing a facility, considering the type of materials and resources that can reduce the impact of the materials’ life cycle is essential. Some material issues should not be overlooked, such as the impact of materials on indoor air and durability of materials. Also, durable and easy to maintain materials should be selected to reduce waste and prevent unnecessary expenditures for material replacement and maintenance [6].

- Art: One goal of art is to provide an image that offers stress reduction: Figure 3
- Ceiling: The ceiling should provide a positive distraction or indirect lighting where patients are recovering.
- Colour: Colour perception can impact patients healing. When choosing colours, keep in mind that the elderly experience colours differently.
- Lighting: The lamp colour temperature is important because it can change the colour of floor and wall materials by dulling or enhancing their colour. This can also be affected by direct or indirect lighting [7] Figure 4.
- Interior Design and material selection process. The following areas of sustainable design should be explored.
  - Recycled Content
  - Resource Reuse
  - Regional Materials
  - Certified Wood
  - Furniture and Medical
  - Low Emitting Materials: Adhesives and Sealants, Wall and Ceiling Finishes, Flooring Systems, as LEED (Leadership in Energy and Environmental

4. Colour psychology

There is a considerable amount of published material, some empirical and much anecdotal, giving advice on colour application using theories of colour psychology. However, from experience, it is suggested that this should not be followed indiscriminately. Contextual variables such as building materials used in construction, window positions or lighting, size of space, nearness of adjacent buildings or surface quality of materials can all dramatically affect colour appearance and behaviour of colour and override colour psychology recommendations.

These problems can be solved by a well-planned colour scheme which bases the colours selected for the building on a wide range of criteria which colour psychology theories cannot always cover. Some guidance is given below and in recommendations on the usage of colour should also be applied carefully as over-use of a certain colour can cause problems. For example, overuse of green or blue colours, renowned for their calming effects, in mental healthcare environments may actually exacerbate depression. A priority should be that colour and lighting schemes should be developed that enhance the building and create spaces where harmony is visible.

Patient satisfaction is the new buzzword. It is the difference between providing what a patient needs and what a patient wants. It is important not only to satisfy clinical needs, but also to meet psychological
expectations, which includes comfort and compassionate care [9].

As it is well documented that noise in hospitals can interfere with patient healing, lead to stressed and less satisfied healthcare workers, and raise the risk of medical errors, the acoustical design of the room played a key role in making that vision a reality.

The combination of design elements and materials in these suites ensures that every noise that can enter or leave the patient room has been addressed and abated as much as possible,” said Carol Fellows, nurse manager with the University of Minnesota Children’s Hospital, Fairview. “As a result, these Adopt Room suites are promoting less patient and family anxiety, faster recovery, and improved patient satisfaction.” [10]

Colour and daylight do, of course, have a practical and functional use in patients’ accommodation. Used with subtlety in all environments, it can be used to control reflected light, to make the most of available daylight and to help reduce glare and material performance [11].

5. Case study for room colour change sustainability in Children’s Hospitals and Clinics of Minnesota, USA

The selected case study is located on Minneapolis, MN (44.9°C – 93.2°C) as shown on Figure 6, then selecting a random room to be simulated to measure the effect of changing room colours on daylight factor, which is considered major factor in Physiological side for the patient. The selected room is located on the north side of the hospital as shown on Figure 7.

The weather data used for Autodesk Ecotect for Minneapolis city was analysed as shown on Figure 8.

All the daylight studies were made to measure the average daylight factor over the year assuming that the average overcast skylight is 8500 lux and the window transparency is 0.9.

Analytical study with chosen patient room as shown in Figure 9 to measure -by using software Ecotect- the effect of changing daylight as one of the important factor of environmental impact with patient psychology when we change the colour of walls, ground floor and furniture.

5.1. Wall colour study

- Current case: Analysing the current room Figures 10 and 11 with the current walls colour which is pale yellow (216,216,178) with (0.831) the result surface reflectivity is 14.03% daylight factor.
Figure 9. Adopt room headwall at the University of Minnesota Children’s Hospital – Fairview in Minneapolis [10]

Figure 10. Wall colour – Ecotest results

Table 1. Results of changing walls colour

<table>
<thead>
<tr>
<th>Wall plaster color</th>
<th>Surface reflectivity</th>
<th>Daylight factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow (216,216,178)</td>
<td>0.831</td>
<td>14.03 %</td>
</tr>
<tr>
<td>Green (170,221,173)</td>
<td>0.786</td>
<td>12.41 %</td>
</tr>
<tr>
<td>Red (233,156,128)</td>
<td>0.690</td>
<td>11.67 %</td>
</tr>
<tr>
<td>Blue (165,185,243)</td>
<td>0.727</td>
<td>11.87 %</td>
</tr>
</tbody>
</table>

• Changing the walls colour to green (170,221,173) with (.786) surface reflectivity is 12.41% daylight factor.
• Changing the walls colour to red (233,156,128) with (.690) surface reflectivity and achieving 11.67% daylight factor.
• Changing the walls colour to blue (165,185,243) with (.727) surface reflectivity and achieving 11.87% daylight factor. So from the results it can be concluded that the pale yellow colour in plaster walls achieved the best possible day lighting (see Table 1).

Figure 11. Wall colour study

Table 2. Results of changing ground floor colour

<table>
<thead>
<tr>
<th>Ground floor colour</th>
<th>Surface reflectivity</th>
<th>Daylight factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow (216,216,178)</td>
<td>0.592</td>
<td>14.03 %</td>
</tr>
<tr>
<td>Green (158,233,159)</td>
<td>0.794</td>
<td>15.71 %</td>
</tr>
<tr>
<td>Silver (212,212,212)</td>
<td>0.831</td>
<td>16.09 %</td>
</tr>
</tbody>
</table>

• Ground Floor colour study
• From the previous study cases Figures 11 and 12 the yellow walls plaster was the optimum case for walls which has colour of walls that is yellow (216,216,178) with (0.831) surface reflectivity and ground colour grey (151,151,151) with surface reflectivity (0.592) is 14.03 % daylight factor.
• Then changing the ground colour to green (158,233,159) with (0.794) surface reflectivity 15.71% daylight factor.

• Then changing the ground colour to silver (212,212,212) with (0.831) surface reflectivity and achieving 16.09% daylight factor.

The results above it can be concluded that the yellow colour in plaster of walls achieved the best possible daylighting (see Table 2).

5.2. Furniture colour study

From the previous study cases. the case that has colour of walls that is yellow (216,216,178) with (0.831) surface reflectivity and ground floor colour that is silver (212,212,212) with (0.831) surface reflectivity using yellow colours for furniture to achieve 16.09% daylight factor. From the previous study cases. the case that has colour of walls that is yellow (216,216,178) with (0.831) surface reflectivity and ground floor colour that is silver (212,212,212) with (0.831) surface reflectivity using yellow colours for furniture to achieve 16.09% daylight factor. However, changing the furniture colour to green and blue and white colour which exists, and keeping the walls and ground colours as previous case the daylight factor changed to 16.45%.

Finally we can conclude that the best case study will be the case that has colour of walls that is pale yellow (216,216,178) with (0.831) surface reflectivity and ground floor colour that is silver (212,212,212) with (0.831) surface reflectivity with green sofa, white bed, blue chair.

5.3. Results

The analysis in this case study was divided on 4 stages. The first stage is to analysis the current room with the current colour of the walls. Second, changing the walls colours with three other colours and try to conduct the best daylight factor case in the three obtained cases. Third, working on the optimum case in the wall colours and change the ground texture and colour in two other cases to obtain the best ground case. Next by the same sequence, the best case with walls and ground colour change furniture colours. Then we get the perfect colours selection of walls, ground and furniture.

Finally we can conclude that the best case study will be the case that has colour of walls is pale yellow (216,216,178) with (0.831) surface reflectivity which get very comfort physiological reflect to the patent and ground floor colour that is silver (212,212,212) with (0.831) surface reflectivity and the furniture green sofa, white bed, blue chair.

The paper aims to realize that the concept of hospitals’ interior design is different from that of all other buildings. The selection of colour, floors, ceilings, walls, furniture, and lighting has its great impact on the wellbeing of sick people and the medical staff. Therefore, the selection is based on certain criteria, specifications, and strong scientific causes that take under its consideration not only the psychological and physiological impacts but also the aesthetic effects on the concerned people.

6. Conclusions

With respect to the sustainability dimension, the research addressed the relationship between the design of interior space colours and day lighting of hospitals and the users’ psychological and physiological aspects to serve adult people.

References