

Biophilic design impact on Healthcare facilities interior design in Egypt

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Abstract:

Patients often suffer from anxiety and long periods of hospitalization, as a result of keeping them away from natural environments. Nature is considered as an effective platform to reduce stress, improve health, psychotherapy, and deter diseases, thus providing patients with easy access to nature elements such as daylight, landscapes, natural ventilation, and green spaces through the merge between these elements and the hospital's internal space could accelerate the healing process and reduce fatigue and psychological stress, therefore reducing the dependence on the drug, especially for patients who spend long time in the same room such as surgical patients. The research focuses on showing the impact of applying the Biophilic design in healthcare facilities interior spaces on human physiology, cognitive functions, reducing patients stay in hospitals and increasing recovery rates.

INTRODUCTION

Humans have used technological advancements to improve their health and welfare in their living and workplaces without considering their physiological needs, as a result, the natural habitat has become the built environment where people spend approximately 90% of their time, therefore most of modern buildings have become separated if not alienated from nature in addition to being places of extensive environmental damage.

Although recent progress in sustainable design has found a solution for this problem, it focused only on reducing

environmental damage and excessive use of resources, without considering reconnecting people with nature in the modern built environment, this reconnecting has been coined as Biophilic design. Over the last quarter century, case studies have documented the impacts of biophilic design on improving human health, including improved stress recovery rates, lower blood pressure, improved cognitive functions, enhanced mental

stamina and focus, decreased violence and criminal activity, and elevated moods.

This research will discuss the idea of the Restorative Impact of Open Space, by showing the influence of daylight and wide windows, natural spaces on the human physiology and cognitive function, and emphasis the implication of biophilia for the healthcare facilities architectural and interior design. In addition to the integration of the healthcare facility design considerations and laws of the natural world with cutting edge technology for patient friendly and sustainable environment in to yield better health outcomes and faster recovery.

OVERVIEW AND BACKGROUND

The research is primarily concerned with defining "Nature" as an important design element and recognizing the biophilic design, then it will explore how deep-plan hospitals' interiors negatively impact the human health. It will also analyze how light and open space plays role in hospitals' interior design to im-

prove patients' health and changing their psychophysiology in order to create human connections to "Nature" within the built environment using a framework of biophilic design.

PROBLEM STATEMENT

1. The lack of emphasis on a human connection to nature in Egypt healthcare facilities despite the current low environmental impact design movement.
2. Lack of interest in patients' physiological needs that affected by separating hospitals interior design from nature.
3. The adverse impact of hospitals' enclosed interiors and deep-plan healthcare facilities on human health.
4. Neglecting the important role of daylight and natural open space in improving human's psychophysiology in healthcare facilities.
5. Converting the incompatible buildings with limited relation to nature, into hospitals in Egypt.

AIMS AND OBJECTIVES

1. Finding the connection between natural systems and the subtle neurological and physiological functions to produce the best designs for the healthcare environment.
2. finding the connection between nature based interior design and healing rates increasing.
3. Using the biophilic design strategies to reduce patients' average length of stay in hospitals.
4. Recognition how to create a suitable healing environment in health establishments in Egypt based on analyzing the current use of natural elements in interior design.

HYPOTHESIS AND METHODOLOGIES

Research assumes that:

1. Creating human connections to nature within the healthcare-built environment to increase healing rates.
2. Integrating nature into architecture will enliven Biophilia's restorative properties, in order to produce the best designs for the healthcare environment.
3. Using the biophilic design strategies and principles could reduce patients' average length of stay

in hospitals.

incorporating biophilic design into the healthcare industry can reduce the cost of both patient care and staffing while improving medical outcomes.

Research Terms:

1. **Biophilia:** The term stemming from the Greek roots meaning love of life, was coined by the social psychologist Erich Fromm, The concept originated as a scientific hypothesis introduced in the early 1980's by Harvard biologist Edward O. Wilson, when he realized the implications of departure from nature, consequently he pioneered a new school of thought focused on the need to bring humans back in contact with nature, he described biophilia as the innately emotional affiliation of human beings to other living organisms. (William Browning N. K., 2012, p. 5)
2. **Biophilic Design:** Is the design of the built environment to reconnect people with nature within modern buildings and landscapes. (Kellert, 2009, p. 3)
3. **Human contact with nature:** The term expresses Any form of direct, indirect, or symbolic connection of the nonhuman world that is integral to people's lives. (Gullikson, 2010, p. 6)
4. **Biophilic engagement:** the term refers to the human contact or connection with beneficial and pleasant experiences of nature. Lack of biophilic engagement has been linked to certain developmental deficiencies and psycho-physiological problems. Increasing biophilic engagement has been linked to many benefits for mind and body. (biophilia, 2019)

1- The First Axis: Biophilic Design

1-1- Biophilia and Connecting people with nature:

The term Biophilia refers to human being's instinctive need to affiliate with nature, the concept of Biophilia is becoming increasingly relevant as it addresses the growing concerns of human disregard for the natural world.

A number of recent empirical studies suggest that connection with nature is not only important because nature provides human with basic needs that are essential for survival, and emotional needs, but also it can benefit human's physical needs , such as provid-

ing him with restorative experiences, expediting healing processes, and reducing sick building syndrome symptoms.

In recent years, Biophilia has been of special interest to architects and designers, spawning the Biophilic Design movement in architecture and design, especially healthcare facilities design. (Gullikson, 2010) (Kellert, 2009) (biophilia, 2019)

1-2- Biophilic design dimensions:

1-2-1- Place Based or vernacular dimension:

buildings and landscapes that connect to the culture and ecology of a locality or geographic area. (Kellert, 2009)

1-2-2- Organic or naturalistic dimension:

it means shapes and forms in the built environment which has:

- **Direct Connection to Nature within the built environment** is a relatively unstructured contact between human in the built environment and the natural environment such as views of the exterior environment, daylight, natural ventilation, water, plants, animals, natural habitats, Landscapes, and ecosystems. photo (1) illustrates a direct connection to nature within the built environment. (Gullikson, 2010) (Messelmani, 2018)



Photo 1 a direct connection to nature within an atrium in an office building for the Houses of Parliament in London designed by Hopkins Architects

- **Indirect Connection to Nature within the built environment** is controlled contact with the natural environment, such as a potted plant, a water fountain, natural materials such as wood, stone, cotton, leather, and wool, or an aquarium. the photo (2) shows an example of an indirect connection to nature. (Gullikson, 2010)



Photo 2 The use of natural materials shows indirect connections to nature inside Frank Lloyd Wright's Fallingwater

- **Symbolic Connection to Nature:** This connection involves no actual contact with real nature, but it represents the natural environment through image, picture, ornamentation, video, metaphor, pictorial expression, and other techniques, shapes and forms that simulate and mimic nature, which could appear in columns, walls, doors, entryways, furnishings, carpets, fabrics, etc. and sometimes it could be an application of a pattern utilizing organic shapes, an obvious symbolic connection to nature is illustrated as photo (3). (Gullikson, 2010) (Kellert, 2009)



Photo 3a symbolic connection to nature through using organic forms at the Ronald Reagan National Airport.

1-3- Biophilic design Elements:

The Ways in which biophilia can be integrated into the design of the built environment. (Salingaros, 2019)

1- Environmental Features: Color – Water – Air – Sunlight – Plants – Animals – Natural materials – Views and visits – Façade greening – Geology and landscape – Habitats and ecosystems – Fire.

2- Natural Shapes and Forms: Botanical motives – Tree and columnar supports – Animal motives – Shells and spirals – Egg, oval, and tubular

forms – Arche, vaults, domes – Shapes resisting straight lines and right angles – Simulation of natural features – Biomorph – Geomorphology – Biomimicry.

3- Natural Patterns and processes: Sensory variability – information richness – Age, change, and the patina of time – fractals – Growth and efflorescence – patterned wholes – central focal point – bounded spaces – transitional spaces – linked series and chains – integration of parts to wholes – complementary contrasts – dynamic balance and tension- Hierarchically organized ratios and scales.

4- Lights and space: Natural Light – Filtered and diffused light – Light and shadows – Reflected light – Light pools – Warm light – Light as shape and form – Spaciousness – Spatial variability – Space as shape and form – Spatial harmony – Inside-outside spaces.

5- Place-based relationship: Geographic connection to place – Historic connection to place – ecological connection to place – Landscape ecology – Spirit of place – Cultural connection to place – Indigenous materials – Landscape features that define building form –Integration of culture and ecology –Avoiding placelessness.

6- Evolved human nature relationships: Prospect and refuge – Order and complexity – Curiosity and enticement – Change and metamorphosis – Security and protection – Mastery and control – Affection and attachment – Attraction and beauty – Exploration and discovery – information and cognition – Fear and awe – Reverence and spirituality.

1-3- Restorative Environmental Design:

Researcher Kellert proposed a design strategy which utilizes two separate design principles: sustainable design principles which employs low environmental impact design principles, minimizes negative effects on natural systems and human health - and biophilic design principles which employs biophilic design principles to facilitate positive contact between people and nature within building this strategy has termed

as Restorative Environmental Design , RED paradigm is as illustrated as Figure (1). (Gullikson, 2010, p. 23) (William Browning N. K., 2012, pp. 17-18)

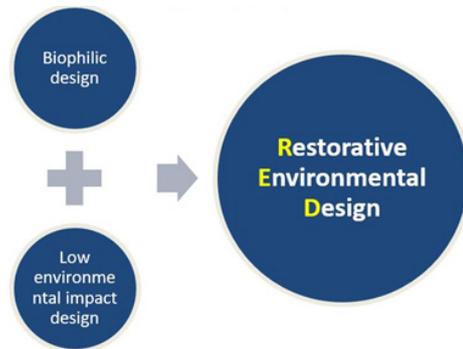


Figure 1 Kellert's proposed design paradigm, Restorative Environmental Design, and its two main components

2- The Second axis: Biophilic design impact on human body system:

Over the last several decades, Research on nature and health field have shown that biophilic engagement has a significant impact on body, mind, behavior and social interaction, in addition to the impact of natural daylight and nature views in improving patients' comfort and healing, stress alleviation, increased sociability, improved measures of physiological stability and health, in healthcare facilities. (biophilia, 2019) Environment impacts on the human neurological and physiological underpinnings by the link between the millions of neural channels in human's brain to his body's autonomic nervous system which consists of two elements, Sympathetic system that stimulates the human body when cognitive function is needed and Parasympathetic system that serves to relax the body .

When human body interacts with nature, the body's natural balance of Sympathetic and Parasympathetic is achieved, the body gets in the ideal state of homeostasis, thus decreasing stress and irritability and increasing the ability to concentrate. While in chaotic and unsettling environments, the body's sympathetic system is highly engaged in a "fight-or-flight" mindset, consequently , the parasympathetic system suppression and disrupting natural balance and re-

sulting in energy drain and mental fatigue. (William Browning N. K., 2012) (Stephen R. Kellert, 2011) (Salingaros, 2019)

2-1- Biophilic design impact on hospital staff:

Nurses and hospital staff feel the effects of anxiety, depression, and lower job satisfaction when they have limited access to views to nature or contact with the outdoors. Correspondingly, staff members recover from stress more easily and perform better when they directly contact with nature.

2-2- Biophilic design impact on visitors:

The benefits of nature in healthcare facilities extend to family members and visitors as well, because nature acts as a positive distraction, to make visitors feel less stressed, more relaxed, rejuvenated, positive, and more able to cope with the situation. (William Browning N. K., 2012)

2-3- Biophilic design impact on Patients: (Documented experiments)

Several studies have been conducted to understand healthcare facilities biophilic design influence on its users through the elements of natural views, daylight and natural distractions, etc. These studies have used patient's health outcomes by observing their signs and symptoms. (Zainab Abbas, 2017, p. 631)

-Blood pressure experiments, Park 2010: The effects of walking through forest atmospheres versus urban areas have been documented by comparing the salivary cortisol, blood pressure, and heart rate of patients. On average, salivary cortisol (a stress hormone) was 13.4-15.8% lower, pulse rate was reduced by 3.9-6.0%, and systolic blood pressure was lower in individuals who walked through the forest, compared with those who walked through urban areas. Parasympathetic activity—which occurs when human feel relaxed—increased by 56.1%, whereas sympathetic activity—which occurs when he feels stressed—decreased by 19.4% in patients who walked through the forest. (William Browning N. K., 2012)

- Forest bathing experiments, Ohtsuka 1998: Experiments were conducted among 87 non-insulin-dependent diabetics over the course of six years to test forest bathing and walking ability to effectively decrease blood glucose levels in patients, patients were also monitored while exercising on indoor treadmills and in indoor pools, to ensure that this was attributable to the forest environment, not simply the walking activity. Indoor exercises reduced blood glucose levels by 21.2%, while forest bathing and walking decreased blood glucose by an impressive 39.7%. (William Browning N. K., 2012)

- Gallbladder surgery, Roger Ulrich study: In 1984, Roger Ulrich measured the restorative effect of natural views on surgical patients recovering from gallbladder surgery in a suburban Pennsylvania hospital (200 beds). Some patients' rooms were provided with natural view, whereas others looked at brick walls, rooms are all nearly identical in terms of dimensions, window size, arrangement of beds, furniture, and other major physical characteristics. Ulrich findings revealed accelerated recovery rates and reduced stress for patients who had nature views. It could also be said that patients whose windows overlooked a scene of nature were released after 7.96 days, compared with the 8.71 days it took for patients whose views were of the hospital's exterior walls to recover sufficiently to be released—a decrease of 8.5%. (Ulrich R. S., 1984)

- Sunlight effect on patients' recovery from a cholecystectomy, Walch et al., 2005: Patients were divided into rooms with varying sunlight. The study determined that patients exposed to greater dosages of sunlight perceived less pain, took 22% less analgesic medications per hour, and accumulated 21% less in pain medication costs for the length of their stay. (William Browning N. K., 2012)

- **Bipolar disorder and depression:** Beauchemin and Hays found in a 1996 study a decreased length of stay for patients in sunny rooms, comparing to those in artificial lighting rooms. In the study of 174

patients with bipolar disorder and depression, those staying in naturally daylight units were released after an average of 16.7 days, while patients in dully lit rooms stayed an average of 19.5 days. (William Browning N. K., 2012).

- **Cognitive or attentional benefits of nature experiences, Cimprich (1990):** In a study of post-surgery breast cancer patients, Cimprich (1990) found that those who participated in a nature-oriented intervention activity showed a consistent gain of attentional capacity, whereas the non-intervention control group did not. (WELLS, 2000, pp. 780-782)

- **Accelerating Recovery time:** The various studies conducted by Ulrich (1993, 2008); Kellert and Heerwagen (2007); Wells and Rollings (2012) to improve the healthcare environment reveals that designs which promote extended exposure to nature result in, accelerated recovery rates, with lower blood pressure, and reduction in consumption of morphine (pain reliever). (Zainab Abbas, 2017)

- Figures (2 – 3) show the effect of nature on muscle tension and blood pressure of patients when compared with views of Pedestrian mall and traffic.

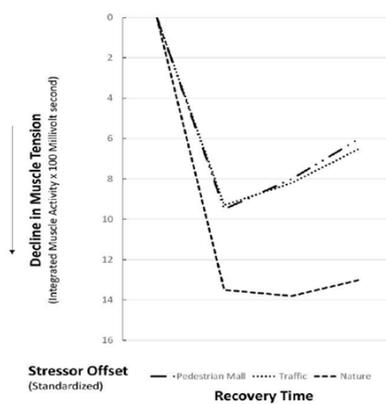


Figure 2 the effect of nature on muscle of patients when compared with views of Pedestrian mall and traffic

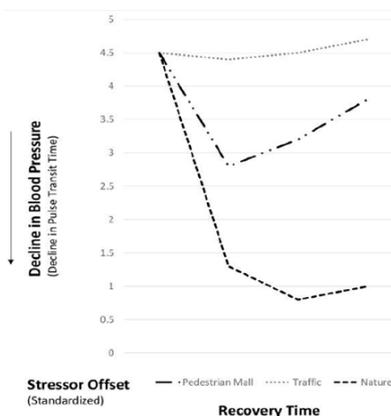


Figure 2-3 the effect of nature on blood pressure of patients when compared with views of Pedestrian mall and traffic

3- The Third Axis: Biophilic design influence on healthcare facilities:

3-1- Patterns to obtain Biophilia-based design Healthcare Facilities:

3-1-1- Merging Nature in the space:

Incorporation of nature elements into healthcare environment, including potted plants, water features, aquariums, and courtyard gardens, as well as views to nature from the inside of a building, and courtyards, because direct connections to nature produce the strongest biophilic reactions.

3-1-2- Using Natural Analogues:

Pictures of nature, furniture with organic shapes and using natural materials fall under the umbrella of natural analogues. The benefits of this connection between human and nature represented in artwork are measurable but less effective than real nature benefits.

3-1-3- Nature of the space:

choosing the building's site. (William Browning N. K., 2012) (William Browning C. R., 2014) (Qing Li, 2012)

3-2- Practical application for a biophilic hospital:

Khoo Teck Puat Hospital:

The hospital promoted the idea of harmony between patients and natural environment through well-integrated design with nature, by choosing the building's site, furnishings design, wide windows and making the hospital become a part of the surroundings.

The hospital had the first ever, Biophilic design award at the Greenbuild Expo in Boston, because of the innovative and extensive use of biophilic design to engage all of the senses to accelerate the healing process and promote wellbeing, by merging the rainforest-like landscaping into the hospital design in order to infuse the atmosphere with natural sights, sounds and scents. (Lilienthal, 2017)

The healthcare building design is based on natural ventilation, flow-through ventilation, light-wells and breezeways, as shown in photo (4)



Photo 4 Khoo Tech Puat Hospital, Singapore

Energy consumption: the facility employs several innovative energy-efficient features, including reducing energy costs by as much as 50%, the collaboration took place with the city to transform the water pond facing the hospital to a lake, photo (5).



Photo 4 the lake facing the hospital

Atmosphere: the hospital has a calming atmosphere, the garden is designed to relieve the anxiety for both patients and staff, that spend long periods in a busy hospital. Sunshades and wide overhangs control the amount of heat and light allowed into the corridors and sky bridges and inside-outside spaces make either waiting or walking in the hospital a more relaxing experience.



Photo 5 Hospital walking and waiting area

Operating rooms or laboratories, and sections of the building requiring air-conditioning were co-located to minimize their external surfaces and heat gain.

Sustainability: merging between sustainable features and biophilic design was so obvious when photovoltaic solar panels have been used to exploit Singapore's tropical sunlight, in addition to

a stormwater management system has introduced to take advantage of Singapore's high precipitation with, for ensuring the hospital's gardens are maintained through stormwater run-off, which can reduce the amount of water being imported from other areas, further reducing the cost and carbon footprint of hospital maintenance. (Johnston, n.d.)



Photo 6 Abstracted Botanical pictures for patients' rooms.

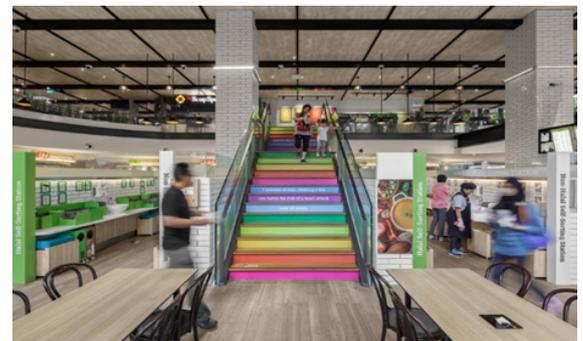


Photo 7 Natural colors in hospital's food hall (foodfare-khoo-teck-puat-hospital, 2019)

Its façade and internal layouts are designed to enhance daylight while reducing glare for all wards. Patients rooms ward large windows to get natural ventilation and a natural view on Yishun Pond, in addition to the integrated facilities such as touch-screen bedside terminals for an enhanced patient experience. (explore_ktph_pages/228/designed_for_comfort, 2019)

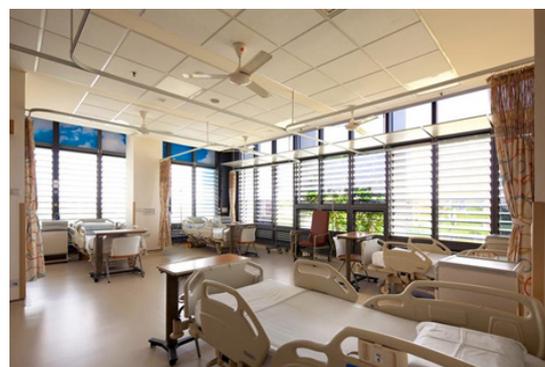


Photo 8 Patients room with large windows to get natural ventilation and a natural view (Tan, 2015)

Hospital questionnaire: a group of 200 users comprised of patients, staff, and visitors, has been sampled, of whom 80 percent responded yes to hospitals investing in implementing biophilic elements. (Lilienthal, 2017)

3-5- Technical Solution for spaces isolated from nature:

Sometimes it's hard to get natural view for patients in healthcare facilities, For this reason, simulating nature technical features such as screens and plasma TVs took place, by processing the interior Spaces & environments of healthcare facilities especially those that lack a visual conduit to a natural views, because the visual connection to nature is the most effective way to relax and provide comfort to patients about to undergo any type of stressful procedure, whether it's a diagnostic, interventional, or therapeutic session. (biophilia, 2019) These screens show view to nature including sky, clouds, branches and blossoms through a glass window could provide patients with the benefit of being in the same view. because simulated nature is measurably better in stress reduction than having no natural visual connection at all. this self-contained system works through a professional-grade monitor embedded within an artificial skylight framework, to result a multisensory illusion that imbues interior environments with a restorative conduit to open skies, triggering the automatic the relaxation response that patients experience in nature. (William Browning C. R., 2014, p. 25)

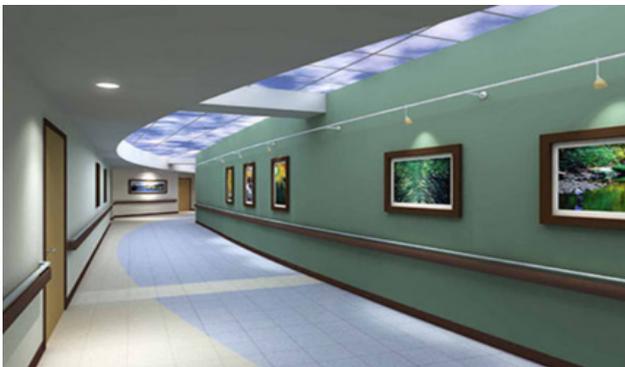


Photo 9 Sky ceiling at North Community Hospital in the United States of America, USA, to solve the problem of lack of windows in corridors.

3-5-1- A case study:

Sky factory's luminous sky ceilings is a company specialized in sky ceiling screens research and manufacture, Navarrete, David A. 2015 have examined the positive impact of Luminous sky Ceilings on acute stress and anxiety in a controlled clinical setting, by creating a genuine illusion of nature in the hospitals. Research examined the behavioral and clinical impact of using the virtual skylight screens on 181 patients in a medical-surgical inpatient unit at Covenant Health Hospital in Lubbock, TX. for eight-month in identical rooms. The study found that using the virtual skylights effectively reduced the stress level by 53.40% and reduced Anxiety level by 34.79%. (Navarrete, 2015)

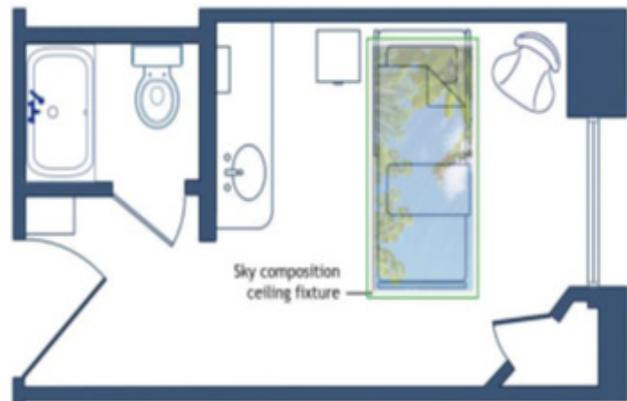


Figure 5 – Photo 11 Luminous Sky Ceiling over the patient bed. Diagram courtesy of Texas Tech University's Dept. of Design.

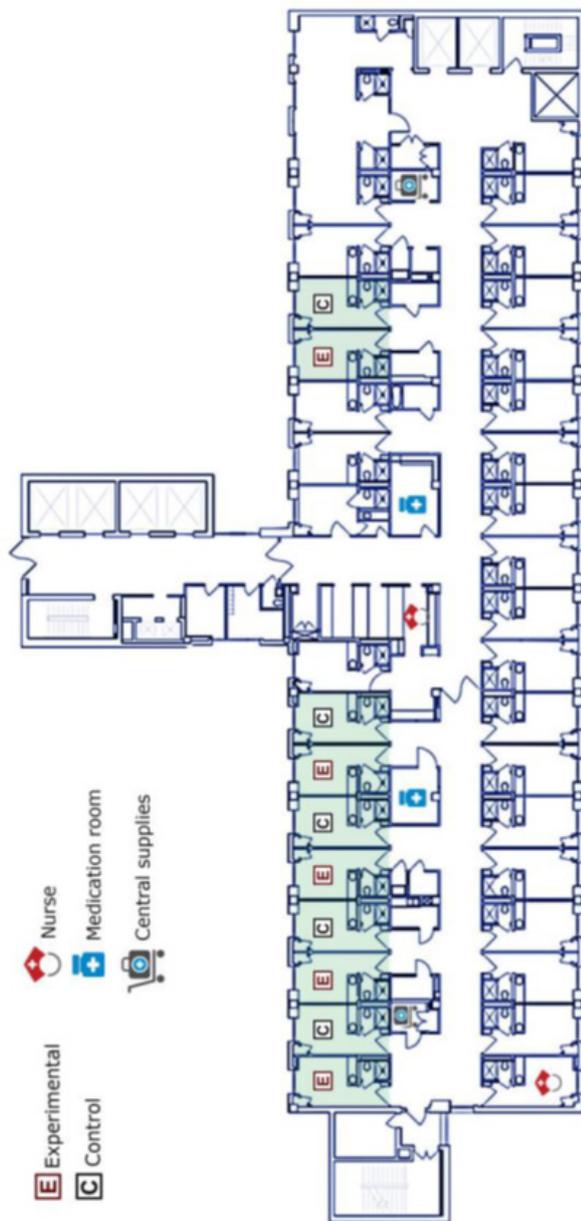


Figure 6 Covenant Health Hospital, floor layout. Diagram courtesy of Texas Tech University's Dept. of Design.

3-6- Considerations for the biophilic design application on healthcare facilities in Egypt:

Before designing a healthcare facility in Egypt:

1- It's vital that designer recognize the limitations, the potential of a hospital site, as well as what's available to the patient and the staff. Also Location, both geographically and in a broader economic sense, is an important aspect of hospital design, designer has to be realistic with his aims, resources and look at maintaining things from a long-term view,

for instance, following independence of Papua New Guinea from Australia, the country tried to replicate the same complex hospital designs of their colonial masters. Rather than design according to economic limitations, the country tried to introduce new technologies that required dedicated upkeep and a consistent power supply. The consequence; the buildings and technology inside fell into disrepair, resulting in hospitals that could barely function on a basic level, never mind as a state-of-the-art medical institution.

2- it's too important that designer Adds:

- Depth and 3-dimensionality because Nature is not 2-dimensional.
- Rough lines instead of straight lines in hospitals interior design, because items are rarely perfectly straight in the natural world.
- Organic shapes instead of geometric shapes, because geometric shapes are man-made, organic shapes are natural.
- Naturally inspired color schemes that often found in nature, such as choosing shades of blue to mimic sky and water.
- Using golden sections, fractals and other grids based on nature – Fractals are complex shapes defined mathematically and are often found in nature. (Bradley, 2010)

6. CONCLUSIONS

The research concluded that Human beings have an innate love of nature, because of nature's influence on physical, psychological, and social wellbeing, therefore healthcare facilities need to incorporate the built environment into a natural environment, un order to create a place which is welcoming to patients, general public as well as to the medical staffs.

Providing the healthcare facility with access to natural daylighting, outdoor views, and natural ventilation, integration of daylighting, natural views, and plants and greenery into healthcare facilities' interior design can relieve patients fatigue and speeds up the healing process, It could also be said that adding natural imagery or organic-design furniture leads to increase healing rates.

7. RESULTS:

1- The research concluded that Biophilic Design is the design of the built environment to reconnect people with nature within modern buildings and landscapes, and the human contact with nature is integral to people's lives.

2- The research has resulted that nature as a positive restorative environment for humans is an effective platform for stress management, health promotion, psychotherapy, and disease deterrence, Accordingly, providing access to natural daylighting, outdoor views, natural ventilation and the integration of plants and greenery into the hospitals' interior space could relieve mental fatigue and speeds up the healing process, reduced psychological stress, Furthermore, scenes of nature in artwork and murals can also reduce anxiety and discomfort, although they are not as impactful as dynamic types of nature.

3- The research has associated biophilic elements as primary influences for faster recovery rates for patients, decreased dependency on medication, reduced staff and family stress, and improved emotional wellness as a result of natural daylighting and views to nature.

4- The research has focused on showing the influence of daylight and wide windows, natural spaces on the human physiology and cognitive function.

Human body is healed through direct exposure to natural environments, and people are recovering faster from major illnesses and medical surgery when they have direct contact with nature. Natural views elicit positive feelings, reduce fear in stressed patients, hold interest, and may block or reduce stressful thoughts, they might also foster restoration from anxiety or stress.

5- Patients often experience considerable anxiety and hospital confinement limits their access to outdoor environments almost entirely to views through windows, therefore views to the outside may be especially important to individuals who have unvarying schedules and spend a great deal of time in the same room, such as surgical patients. It is possible that a hospital window view could influence a patient's emotional state and might accordingly affect recovery.

6- The application of Biophilic design into the designing of interior spaces in a healthcare facility has a great implication on users, such as decreasing anxiety and stress levels, decreasing hospital stay and increasing recovery rates and satisfaction from the patient itself.

8. RECOMMENDATIONS:

- The concept of Biophilia and combining the Biophilic hypothesis and biophilic elements in healthcare facilities design have to be presented in Egypt to enhance the health, wellbeing and

quality of life of the users on one hand and improving the building performance and sustainability on the other, because it could be the way forward in a future of sustainable and green conscious designs.

- Egypt healthcare facilities have to be provided with indoor gardens, fountains and ponds, also healthcare buildings should be oriented to get maximum sun to ensure that patients have abundant natural light through skylights and windows and Presenting more views of the outside world.
- Egypt healthcare facilities should Avoid deep plans, since the lack of sunlight would create a distressing and depressing ambience in rooms, worsening the condition of the patient and deducting the staff morale.
- Areas dedicated for sitting in Egypt hospitals should have large windows with views of nature, especially areas where the environment is stressful like emergency rooms, waiting areas and staff rooms.
- Egypt Healthcare facilities should include gardens with natural contents, flexible seating for socializing and relaxing, spaces allowing privacy, good way finding and opportunities for physical movement or exercise with ease of access to shaded area, in addition to a playing area for kids.
- Integration of biophilia design in healthcare facilities is not only by merging natural items into the built environment, but also it could be through visual art and technology, through natural represented in paintings, photographs, prints, television screens, eye glass displays, etc. it could be introduced into the facilities where it might be difficult to provide views or gardens.
- the interior designer should create spaces that yield a better compatibility between patient and built environment, by merging the biophilic design dimensions with the desired performance of the interior space, in order to provide hospitals with a healthy environment and decreasing the duration of patients stay.

7. References

1. biophilia. (2019). Retrieved from skyfactory: <https://www.skyfactory.com/biophilia/>
2. Bradley, S. (2010, May 10). biophilia-effect. (vanseodesign) Retrieved from vanseodesign: <https://vanseodesign.com/web-design/biophilia-effect/>

3. explore_ktph_pages/228/designed_for_comfort. (2019). Retrieved from ktph: https://www.ktph.com.sg/main/explore_ktph_pages/228/designed_for_comfort
4. foodfare-khoo-teck-puat-hospital. (2019). Retrieved from wallflower: <https://wallflower.com.sg/foodfare-khoo-teck-puat-hospital/>
5. Gullikson, C. (2010). Human Connection to Nature within the Built Environment: An Exploration of Office Employee Perception of Nature Connectedness. Florida: Florida State University Libraries. Retrieved June 11, 2010, from lib-ir@fsu.edu
6. Johnston, C. (n.d.). the-architects-perspective-khoo-teck-puat-hospital/. Retrieved from rmjm: <https://www.rmjm.com/the-architects-perspective-khoo-teck-puat-hospital/>
7. Kaplan, S. (1995). The Restorative Benefits of Nature: Toward an Integrative Framework. *Journal of Environmental Psychology*, 15, 169–182.
8. Kellert, S. H. (2009). *Biophilic design: The theory, science, and practice of bringing building to life*. Hoboken, NJ: John Wiley.
9. Krister Nilsson, E. S. (n.d.). drottning-silvias-barnsjukhus. Retrieved from whitearkitekter: <https://whitearkitekter.com/se/project/drottning-silvias-barnsjukhus/>
10. Lilienthal, L. (2017, 11 13). First-Annual-Stephen-R-Kellert-Biophilic-Design-Award-Goes-Khoo-Teck-Puat-Hospital. Retrieved from 3blmedia: <https://www.3blmedia.com/News/First-Annual-Stephen-R-Kellert-Biophilic-Design-Award-Goes-Khoo-Teck-Puat-Hospital>
11. Messelmani, A. E. (2018). *Biophilia, Humans & the Connections*. NICOSIA: University of Nicosia.
12. Navarrete, D. A. (2015). Luminous SkyCeilings Reduce Acute Stress by Half. *Health Environments Research & Design Journal*.
13. Qing Li, M. K. (2012). Effect of phytoncides from forest environments on immune function. *Research gate*, Ari itoh-nakadai.
14. Salingaros, N. A. (2019). The Biophilic Index Predicts Healing Effects of the Built Environment. *Journal of Biourbanism*, 8.
15. SkyView. (2019). Retrieved from skyfactory: <https://www.skyfactory.com/products/SkyView/>
16. Stephen R. Kellert, B. F. (2011). *BIOPHILIC DESIGN The Architecture of Life*. Retrieved from biophilicdesign: <http://www.biophilicdesign.net>
17. Tan, L. (2015, 11 6). singapore/policyholders-sticking-with-ips. Retrieved from straitstimes: <https://www.straitstimes.com/singapore/policyholders-sticking-with-ips>.
18. Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, 420.
19. Ulrich, R. S. (1993). Biophilia, biophobia, and natural landscapes. *Research Gate*, 73-137. Retrieved from https://www.researchgate.net/publication/284655696_Biophilia_biophobia_and_natural_landscapes?enrichId=rgreq-872999cd5d-5b6153a6ba4a9f0090549b-XXX&enrichSource=Y292ZXJQYWd1OzI4NDY1NTY5NjtBUzozNTQ3ODUwNzQxMzkx-MzZAMTQ2MTU5ODc2MTc2Ng%3D%3D&el=1_x_2&_esc=publi
20. WELLS, N. M. (2000). AT HOME WITH NATURE Effects of “Greenness” on Children’s Cognitive Functioning. *ENVIRONMENT AND BEHAVIOR*, 32, 775- 795. Retrieved November 6, 2000, from https://www.ncrs.fs.fed.us/pubs/jrnl/2000/nc_2000_wells_001.pdf
21. William Browning, C. R. (2014). 14 patterns of biophilic design. New york: © 2014 Terrapin Bright Green, llc. Retrieved October 16, 2014, from www.terrapinbrightgreen.com
22. William Browning, N. K. (2012). *THE ECONOMICS OF BIOPHILIA, WHY DESIGNING WITH NATURE IN MIND MAKES FINANCIAL SENSE*. New york: Terrapin Bright Green LLC.
23. Zainab Abbas, A. M. (2017). Biophilia and Built Environment: An Implication for Healthcare Facilities. *International Journal on Emerging Technologies*, 8, 628-6