



Architectural Daylighting in Hospitals: A Path to Faster Healing and Well-Being

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Abstract : This study explores the healing effects of natural light in medical settings, highlighting how it may be a non-invasive yet effective aid in patients' recuperation. Daylight has drawn attention for its biological and psychological advantages, which range from regulating circadian cycles to reducing stress, pain, and hospital length of stay, as healthcare design increasingly integrates concepts of healing and well-being. This study examines clinical case studies, empirical results, and architectural techniques that improve daylight access in hospital settings, drawing on evidence-based design (EBD) literature. It highlights important interventions that might enhance patient outcomes in critical care, maternity, and recovery rooms, such as biophilic design components, circadian lighting systems, and thoughtful window placement.

IndexTerms - Natural light, LOS, Biophilic, Hospital, Architecture, Healing

I. INTRODUCTION

The focus of Architectural in hospital design has changed in recent years from purely practical factors to the creation of spaces that actively support recovery and wellbeing. Natural daylight is one of the numerous architectural features being studied that has been shown to have a significant, non-invasive impact on patient outcomes. Clemson University (2017). In addition to being necessary for visual activities, light is also biologically important for controlling mood, hormone cycles, circadian rhythms, and general physiological processes. As a result of these impacts, there is increasing interest in using natural light in hospital architecture to promote healing and shorten hospital stays.

In a variety of patient populations, exposure to daylight has been associated in several evidence-based design (EBD) studies with decreased stress, decreased pain perception, enhanced sleep patterns, and accelerated healing rates. Ratti, C., et al. (2011)

These results are particularly relevant in clinical settings where environmental stresses can either promote or impede the healing process, such as recovery rooms, maternity wards, and critical care units.

Through an analysis of empirical research, case studies, and architectural methods, this article investigates the connection between hospital recovery durations and exposure to natural sunshine. It also takes into account how architectural interventions, such the positioning of windows, the orientation of the room, and daylight-mimicking devices, might improve patient outcomes. Using this perspective, the study emphasizes the value of daylight as a therapeutic tool that may improve hospital stays and medical results, rather than just being a design choice. Kellert, S. R., et al. (2008)



Fig 1,2,Natural Light in room,Natural Light in Corridor
(Source:heart-heal-clemson-researchers)

2.CONNECTION BETWEEN HOSPITAL RECOVERY DURATION AND EXPOSURE TO NATURAL SUN LIGHT

In healthcare design, there has been a growing interest in the connection between hospital recovery times and exposure to natural sunshine. Access to natural light has been shown in several studies to have a substantial influence on patient outcomes, especially when it comes to shortening hospital stays and enhancing general recuperation.

2.1 IMPACT ON LENGTH OF STAY (LOS)

Studies show that patients who are exposed to natural sunshine stay in hospitals for shorter periods of time than those who are in rooms with no windows or with poor lighting. Patients who had window views and access to sunshine, for example, stayed 16.8 hours less than those who did not, according to a research done in a cardiac critical care unit. The potential advantages of natural light in critical care settings were highlighted by this reduction in length of stay, which was especially noticeable among patients on mechanical breathing.

A thorough retrospective analysis of the effects of window views and daylight exposure on patient length of stay (LOS) was carried out in a cardiac intensive care unit (CICU) in the southeast United States. Between 2015 and 2019, 2,319 patients' data were evaluated for the research, which divided the rooms into three categories:

Type A: Spaces that have windows and daylight (beds positioned parallel to full-height, south-facing windows).

Type B: Light-filled rooms without window views, where the bed is positioned perpendicular to the window.

Type C: Rooms without windows.

The study discovered the following after adjusting for factors including age, clinical conditions (such as heart failure, hypertension, and cardiogenic shock), and the severity of the illness:

Mean LOS:

Type A: 2.8 days

Type B: 3.1 days

Type C: 3.5 days

Accordingly, the length of stay (LOS) for patients in Type A rooms was 16.8 hours less than that of patients in Type C rooms and 7.2 hours shorter than that of patients in Type B rooms.



Fig 3,4, Room Layout, Natural Light From Window
(Source: heart-heal-clemson-researchers)

2.2 CASE STUDY

Example 1: Southern-Exposure Rooms in a Cardiac ICU – Seoul, South Korea

The effect of window exposure and room orientation on recovery durations in a cardiac intensive care unit (CICU) was assessed in a 2023 study that was published in the International Journal of Environmental Research and Public Health. The study observed 2,172 patients in Seoul National University Bundang Hospital. Patients put in rooms with south-facing, floor-to-ceiling windows had considerably shorter durations of stay (LOS) than those in windowless or less light rooms. Specifically, those expecting to remain ≤ 3 days recovered almost one day quicker in well-lit rooms. Natural light and outdoor vistas were considerably more beneficial for those with mental health issues like dementia or anxiety.

Example 2: United States Maternity Ward Room Placement and Recovery

A presentation at the American College of Surgeons Clinical Congress 2022 highlighted how hospital room elements, like natural light and vistas, favorably improve patient outcomes. The study's findings are pertinent to maternity care even though it included a wide range of patients. It was found that rooms with more windows and sunshine exposure had a 20% reduced risk of death and a quicker rate of patient recovery. This implies that moms who recuperate in window-side beds after giving birth could also have better health and shorter postpartum stays.

Example 3: Danish Windowless Coronary Care Unit with Circadian Lighting

In a Danish randomized controlled experiment, researchers evaluated whether dynamic circadian lighting might mimic the advantages of natural light for patients in a windowless coronary care unit (CCU). The lighting system used color temperatures

between 2700K and 6500K to replicate daylight changes. The study represented a significant advance in the use of artificial light to replicate natural cycles in critical care facilities, even if no discernible differences in length of stay or delirium rates were detected when compared to normal illumination.

3. ARCHITECTURAL STRATEGY

An efficient architectural technique that greatly enhances patient healing, well-being, and the overall hospital experience is the integration of natural sunshine into healthcare spaces. The following are essential tactics for creating medical facilities that efficiently utilize natural light:

1. Placement of Windows Strategically

Optimize Light Access: Arrange common spaces, hallways, and patient rooms to maximize daylight and provide unhindered views of the outside. The Heschong Mahone Group (2003).

Building Orientation: To optimize solar exposure, buildings should be designed with an ideal orientation. For example, in temperate areas, windows facing south receive the most steady sunshine throughout the day.

Room Layouts: Steer clear of deep rooms and places distant from outside walls since they could not receive enough natural light. To guarantee that daylight reaches deeper locations, create floor designs that are shallower.

2. Use of Skylights and Light Wells **Skylights:** Include skylights in roof designs to provide natural light into interior spaces, particularly in places like waiting rooms, toilets, and hallways that lack outside walls. Ulrich, R. S., et al. (2008)

Light Wells: To direct natural light into the center of a multi-story building, light wells can be created. These areas need to be thoughtfully planned with the right shading strategies to prevent glare and overheating.



Fig 5,6, Window Placement, Building Orientation
(Source: santacruzarchitect.wordpress.com, sustainabilityworkshop.venturewell.org)

3. Floor-to-ceiling windows and glass walls

Transparency: Provide unhindered views of the outside world by using wide, transparent glass windows and walls, especially in patient rooms, lounges, and common areas. Ratti, C., et al. (2011)

Floor-to-ceiling windows: These windows may let in more natural light and open up rooms and areas, giving them a sense of spaciousness.



Fig 7,8, Skylight, Light well
(Source: thearchitectsdiary.com, dezeen.com)

4. Lighting Systems That Simulate Daylight

Using dynamic lighting systems that replicate the natural daylight cycle is known as circadian lighting. Especially in areas without windows, these systems help patients sleep better and feel happier by adjusting the color temperature and intensity of artificial illumination throughout the day. Kopec, D. A. (2006).

Light Sensors: Depending on how much natural light is present in the room, daylight sensors may be used to automatically modify the artificial lighting's intensity. This guarantees that the illumination is constantly at the ideal level, saving energy while preserving a suitable atmosphere.

5. Control of Glare and Shading

Devices for Shading: To reduce brightness and avoid overheating, use louvers, blinds, or shades. These may be made to minimize uncomfortable direct sunlight while still letting in light. The Center for Health Design (2013)

Adjustable Window Systems: Take into account adding smart windows or glazing systems that may be adjusted in opacity according to the amount of sunshine.

6. Interiors with light colors and reflective surfaces

reflecting Materials: To improve the way natural light is distributed around the room, use light-colored and reflecting materials (such as white walls, light-colored floors, and ceilings).

Light-Colored Furnishings: To enhance the impact of daylight, use furniture that reflects light.



Fig 9,10,Floor-to-ceiling windows ,Control of Glare and Shading
(Source:abglassandmirror.com,atriadesigns)

7. Integration of Biophilic Design Connection to Nature: To further improve the healing impact of natural light, use biophilic components like plants, natural textures, and vistas of natural landscapes in addition to sunshine.Kellert, S. R., et al. (2008).

Outside Access: Provide simple access to outside areas or gardens so that workers, relatives, and patients may go outside and enjoy some fresh air. The therapeutic benefits of natural lighting can also be strengthened by direct access to green areas.

8. Considering Patient Needs When Designing

Patient-Centric Layout: Make sure each patient room has a window, ideally one that overlooks the outdoors, and think about how to position the bed to maximize natural light.Knight, C., & Haslam, S. A. (2010).

9. Taking into Account Particular Hospital Critical Care Units (ICU): Use circadian lighting systems and make sure patients have visual access to nature through artwork or digital windows that replicate outside vistas in recovery rooms or critical care units where natural light may be scarce.

Maternity Wards: Using daylight exposure in maternity wards is essential for enhancing women' overall emotional experience and promoting a quicker recovery after giving birth.Ulrich, R.S., et al. (2008).

10. Energy Efficiency and Sustainability

Sustainable Design: To maximize natural light use and reduce energy usage, apply passive solar design concepts. The demand for artificial lighting and HVAC systems may be decreased with careful window placement, shading, and insulation.International Energy Agency (2016).

4.ADVANTAGES

Better Health and Recuperation Results for Patients:

Exposure to natural sunshine has been associated with improved sleep quality, a quicker recovery, and less discomfort. According to a research, patients who have access to natural light in their rooms stay in the hospital for shorter periods of time than those who do not (Clemson University, 2017).

Improved Emotion and Mental Health:

Natural light exposure is linked to better mental health and mood, as well as a decrease in stress, anxiety, and sadness. According to a research by Ulrich et al. (2008), natural light may contribute to increased psychological comfort in medical environments.

Length of Stay (LOS) Reduction:

Patients who remain in rooms with lots of natural light typically stay for shorter periods of time. According to a 2003 research by The Heschong Mahone Group, patients in windowed rooms recovered far faster, particularly in the cardiac and orthopedic divisions.

Efficiency of Energy:

Effective use of natural light may help hospitals use less artificial lighting, which lowers operating costs and saves energy. A 2013 research by The Center for Health Design found that by lowering lighting expenses, integrating daylight into hospital designs may save up to 20% on energy use.

Improved Sleep Quality:

Exposure to natural sunshine controls circadian cycles, which enhances sleep quality and promotes quicker recovery. A 2011 research in the Journal of Clinical Sleep Medicine found that exposure to light during the day improves sleep quality at night, which benefits general health.

Advantages of Biophilic Design:

One important component of biophilic design, which has been demonstrated to lower stress and elevate mood, is using natural lighting. Natural light is crucial for both physical and mental wellness in healthcare settings, according to the International WELL Building Institute (2018).

Beneficial Effect on Employee Well-Being:

Employees at hospitals who work in areas with natural light report feeling less tired, happier, and doing better. According to a 2010 research by Knight and Haslam, employees who work in well-lit areas are more satisfied with their jobs and are more productive.

5. CHALLENGES**Design Limitations in Existing Buildings:**

It can be difficult and costly to retrofit older hospital facilities to use natural sunshine. For example, it is difficult to integrate natural light in many older buildings since they do not have window access. According to a 2003 case study by Hescong Mahone Group, many hospital buildings still in use need to be significantly altered to allow for natural light.

glare and excessive heat:

Overexposure to daylight can cause discomfort, overheating, and glare. To reduce glare and avoid overheating, proper shading and movable glazing solutions are essential. Kopec (2006) highlighted the significance of limiting direct sunlight in medical facilities.

Privacy Issues:

When designing a hospital, privacy is a top need, especially when big windows are used to let in natural light. It might be difficult to maximize daylight while maintaining seclusion. To preserve privacy in patient rooms, the Center for Health Design (2013) recommends the use of frosted glass, curtains, or smart glass.

Geographical and climatic constraints:

It might not always be possible to maximize sun exposure in areas with lengthy winters or overcast skies. Excessive sunshine can raise cooling requirements in warmer climates, making energy efficiency difficult to manage. Geographical location influences the advantages of daylight in hospital design, claim Ratti et al. (2011).

Harmonizing Artificial and Natural Lighting:

It's crucial to strike the ideal balance between artificial and natural illumination. Artificial lighting systems can still be necessary in places with little access to natural light. In order to supplement daylight consumption, hospitals should use energy-efficient artificial lighting systems, according to a 2016 report by the International Energy Agency.

The price of putting daylight-mimicking technologies into practice:

Installing and maintaining technologies that mimic daylight, such as smart glasses or dynamic lighting systems, can be costly. Such systems have the potential to significantly increase healthcare project costs (Knight & Haslam, 2010).

Disruption Risk in Crucial Areas:

Natural sunshine may interfere with the exact lighting management needed in some hospital spaces, such as operating rooms and intensive care units (ICUs). It can be difficult to strike a balance between the advantages of natural light and the requirement for regulated lighting in particular medical areas, as Kopec (2006) points out.

6. CONCLUSION

Incorporating natural daylight into healthcare design is a crucial, evidence-based approach that has a direct impact on patient health and rehabilitation, not just an aesthetic or energy-saving decision. Exposure to sunshine has been shown in several research and architectural case evaluations to lower stress, increase mood, regulate circadian cycles, improve sleep quality, and even decrease hospital stays. These advantages are particularly important in delicate clinical settings where environmental quality can have a big impact on results, such as intensive care units, maternity wards, and post-operative recovery rooms.

Healthcare facilities may create spaces that actively promote recovery by implementing architectural techniques including biophilic design, daylight-mimicking systems, light wells, and intentional window orientation. This study supports the importance of natural sunlight as a non-invasive therapeutic component and calls for its inclusion in healthcare planning and design as a top priority. In order to create holistic, patient-centered environments where light serves as a tool for both treatment and healing, future hospitals must keep moving beyond functional efficiency. In such type Architecture help to implement daylight in patient recovery.

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