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ENHANCING THE VITALITY OF PUBLIC HEALTHCARE INSTITUTIONS IN INDIA WITH BIOPHILIC DESIGN STRATEGIES

Saurabh Kumar Maurya [1], Swati Agrawal [2], Dr. Bipasha Kumar [3]

[1] Student of M. Arch 1st Year, AIT-SAP, Greater Noida, India
[2] Assistant Professor at AIT-SAP, Greater Noida, India
[3] Professor at AIT-SAP, Greater Noida, India

Corresponding Author
Saurabh Kumar Maurya,
srbhmaurya@gmail.com

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ABSTRACT

Public Healthcare institutions in India are becoming less preferred compared to private healthcare institutions, not because these public facilities have less qualified doctors or staff but because of their old rustic structures and low maintenance of the buildings which are disconnected from nature. Biophilic is an idea to create bonding between a building and its user through landscape and natural essential elements of life like natural light, fresh air and water to improve mental well-being, reduce stress and increase the healing capacity of a human being.

This research is mainly focused on the descriptive research on biophilic design and public healthcare facilities in India and the comparative case studies of KTP Hospital in Singapore and 'Östra Psychiatry Hospital' in Sweden with District Hospital Barmer-Rajasthan and District Hospital Satna- M.P. to understand the feasibility and challenges of the Biophilic concept in healthcare facilities in Indian public healthcare facilities.

The findings of study shows that the user perspective is somewhere also dependent on the architectural or structural condition of the facility along with the qualification of medical staff. The healing process of patients and the mental well-being of staff can be improved by the addition of natural elements in daily life.

This research therefore concludes as a healthcare system it is its responsibility to provide the best possible treatment not just by providing medicine but by a healing environment too, also it is necessary to focus on improving the mental well-being of all the staff including doctors, nurses, supports staffs etc.

Keywords: Public Healthcare, Healing, Patients, Biophilic, User Perspective, Well-being, Natural Elements, Patient-Centric

1. INTRODUCTION

The complex and multifaceted network that is the Indian healthcare system is made up of both public and commercial sectors, offering a range of medical services and infrastructure to the 1.4 billion people living in the nation. (Kumar, 2023). According to the various statistics that are accessible, India undoubtedly lacks public healthcare infrastructure. Public Healthcare institutions in India are suffering from the fact that they are not upgrading the built structures as per the present FAR and environmental norms. For example, Delhi has FAR 375 for hospitals whereas most public (Govt) hospitals are still at 100-150 FAR which were built in the 60's to 80's. However, the question is whether the infrastructure that we do have at the moment is adequate to meet the needs of the underprivileged. In the era of medical insurance, people do not feel safe getting treatment from public hospitals and prefer private hospitals over

public hospitals. Only the low-income group and some from middle-income groups prefer to get treatment from a public hospital. One of the main reasons for the ignorance of public facilities is not because of a lack of good and eligible staff it is because of the existing condition of the infrastructures available. The public healthcare infrastructures are not capable of gaining the trust of the user. In some cases, these structures are old, not maintained and where infrastructures are new and maintained they still can't provide the feeling of improvement in the minds of patients or users. They are just concrete structures with a door and window and do not have any mental connection with the users. One of the main causes of these public healthcare systems' low vitality is the absence of a sense of mental well-being within them. This mentality can be changed by using natural elements and adopting the biophilic parameters in these public healthcare structures which can create a feeling of trust and attract the patients back to use public healthcare facilities that are available by the government on a very low or zero-cost for public benefit only.

This paper will study the biophilic principles and their impact on healthcare buildings focusing on the public sector only to improve their vitality in the public interest. Also, this paper will study the available case studies of some international hospitals that are already using the biophilic principles to benefit their patients as well improving the mental well-being of their staff and will take some examples of Indian Public hospitals to understand their current condition.

2. METHODOLOGY

The present study employed the descriptive research approach to perform a literature review with the aim of comprehending the concept of biophilic design and its implementation in the current Indian public healthcare infrastructure and case study to understand the feasibility of biophilic principles in healthcare institutions comparing with each other focusing on the biophilic experiences. A comparative analysis has been done between international healthcare facilities with the Indian public healthcare facilities of two different states of India.

First of all, we reviewed the literature to understand the biophilic design principles and the impact of these principles on healthcare facilities. After that, we reviewed the fact of why public healthcare facilities in India are less preferred compared to private healthcare facilities. At last case studies were reviewed and compared international healthcare facilities with Indian public healthcare facilities. The international case studies are based on the literature available, but the Indian case studies are done by the author himself sometimes back.

3. LITERATURE REVIEW

3.1. BIOPHILIC DESIGN

Biophilic design is a strategy that offers a sustainable design approach that includes reestablishing human connection with the natural environment, as championed globally by Kellert et al. (2008) and Beatley (2010). Table 1 lists the fundamental ideas for the effective implementation of Biophilic design. (Kellert, 2015).

Table 1: Biophilic principles, Image source: The Practice of Biophilic Design (2015)

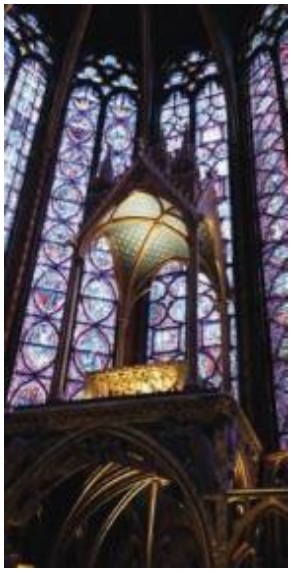
S.no	Principles	Figure
01	Engagement with nature	
02	Human adaptations	

03	Emotional attachment	
04	Positive interactions	
05	Connected architectural solutions	

The review of the literature demonstrates that using biophilic design calls for a variety of design approaches, or what are known as "different kinds of experiences." Using a specific design technique, one can adopt the kind of experience a user needs (Totaforti, 2018).

The three main categories of natural experiences that correspond to the biophilic design framework categories are listed in Table 2:

Table 2: The Biophilic Design Framework's Categories (Kellert, 2015)

Type	**Direct Experience of the Nature**	**Indirect Experience of the Nature**	**Experience with space and place**
Definition	Actual contact Environmental features	Interaction with an image or representation of nature	The natural environment's spatial aspects are what have improved human health and well-being.
Attributes	Natural landscapes and ecosystems, light, air, water, plants, animals, and weather Flames	a picture of nature organic materials, Organic Colors mimicking the hues and lighting of nature, naturalistic outlines and contours, calling to mind the natural world, richness of information Age: the wear and tear of time, organic shapes, Biological Modeling	Prospect and safety, arranged intricacy, combining elements to form wholes, spaces in transition, Mobility and path discoveries, ecological and cultural ties to a location.
			

3.2. BIOPHILIC DESIGN

Biophilic design is divided into three categories: Natural Analogues, Nature of the Space, and Nature in the Space. These classifications offer a structure for comprehending and permitting the deliberate integration of diverse tactics within the constructed surroundings. (Wai, 2018)

3.2.1. NATURE IN THE SPACE

"Nature in the Space" describes the immediate, ephemeral, and palpable presence of nature in a place. The seven biophilic design patterns seen in Nature in the Space are listed in Table 4. (Wai, 2018)

Table 3: Patterns of Biophilic Design - Nature in Space

S. No.	Design Pattern	Example
1	Visual Connection with Nature.	Observation of biological systems, natural processes, and natural phenomena.
2	Non-Visual Connection with Nature.	Tactile, gustatory, olfactory, or visual sensations that evoke a positive and conscious connection to the natural world, living things, or living processes.
3	Non-Rhythmic Sensory Stimuli	Stochastic and transient links with nature can be statistically investigated, even though they are not always precisely predictable.
4	Thermal & Airflow Variability	Slight fluctuations in the skin's surface temperature, surrounding air temperature, relative humidity, and airflow that mimic natural environments.
5	Presence of Water	A condition where one's sense of the surroundings is enhanced by being near, hearing, or touching water.
6	Dynamic & Diffuse Light	Uses varying light and shadow intensities to create situations that resemble those found in nature.
7	Connection with Natural Systems	Understanding of natural processes, especially the seasonal and temporal fluctuations typical of a healthy ecosystem.

3.2.2. NATURE ANALOGUES

Intangible, biological, and non-living evocations of the natural world are the subject of Natural analogues. There are three biophilic design patterns in Natural Analogues. (Wai, 2018)

Table 4 Patterns of Biophilic Design – Natural Analogues

S. No.	Design Pattern	Example
1	Biomorphic Forms & Patterns.	Symbolic allusions to naturally occurring curved, patterned, textured, or numerical formations.
2	Material Connection with Nature	With minimal modification, natural materials and pieces capture the essence of the local environment or geology, creating a unique sense of place.
3	Complexity & Order.	The rich sensory information is presented in a way that is evocative of the spatial hierarchy found in natural surroundings.

3.2.3. NATURE OF THE SPACE

Nature of the Space talks about natural spatial arrangements. Nature of the Space includes four design patterns that are biophilic: (Wai, 2018)

Table 5: Patterns of Biophilic Design – Nature of the Space

S. No.	Design Pattern	Example
1	Prospect	A far-off, unclouded vision for planning and monitoring.

2	Refuge	A place where one can hide from the action and their surroundings while remaining safe from the front and rear.
3	Mystery	Partially veiled vistas or other sensory devices that draw the person further into the surroundings are employed to hint at further information.
4	Risk/ Peril	A recognizable danger combined with a solid defense.

3.3. BIOPHILIC APPROACH IN HEALTHCARE

The interior environment has a causal impact with human health. When there is partial or insufficient availability of sunlight and ventilation, resulting in disturbing interior air quality, poorly constructed buildings continue to be a serious health risk. (Farhan Asim, 2020)

In a hospital design, the main concern should be to provide not only a room with concrete or glass walls which feels like a jail to its patients after some time but to provide an overall natural environment where the patient can feel healing in mind also. Psychology says that sometimes a positive hope can increase the healing process rather than the medicines. So, incorporating biophilic ideas in a healthcare building can change the overall perspective of its patients, and also can increase the mental well-being of its staff who are working on a tough routine by getting basic experiences inside their workplace like sunline, greenery, blue sky, birds chirping etc.

Studies on the biological reactions to biophilic design patterns typically demonstrate favorable benefits on mood, preference, sensitivity, cognitive abilities, and stress alleviation. (Lee, 2019)

Table 6: Patterns of biophilic design and biological reactions.

	Biophilic responses		
Biophilic design patterns	**Reduction of Stress**	**Mental abilities**	**Sensitivity, Atmosphere and preference**
Visual link to the natural world	lowering the heart rate and blood pressure	Increasing focus and engagement at work	favorable impact on spatial preference
Non-visual relationship with the natural world	Reduces stress and systolic blood pressure.	favorable impact on cognitive abilities	Encouraging mental well-being and psychological poise
luminous and diffused	boosting contentment, comfort, and output	favorable impact on heightened focus	enhancing perception and liking for space
Relationship to natural systems	Reducing anxiety	-	influencing public opinion on the environment and advancing health
Patterns and structures that are biomorphic Tangible relationship to the natural world	-	Reduced diastolic blood pressure	Growing inclination for viewing Encouraging a calm attitude
Order and complexity	Reducing mental strain	-	Growing inclination for viewing
Prospect	Relieving stress	lowering weariness and boredom	enhancing perception of safety and comfort
Refuse	-	enhancing focus and perception of security	enhancing one's perception of security and stability

3.4. CASE STUDIES WITH BIOPHILIC CONCEPT

3.4.1. KHOO TECK PUAT HOSPITAL (KTPH) SINGAPORE

The Khoo Teck Puat Hospital (KTPH) in Singapore has 10,957 square feet of green space in addition to 590 general beds. The hospital's layout includes a waterfall that cascades into a verdant courtyard in the middle, evoking a tropical jungle. The hospital has reduced its energy usage by 33% in comparison to comparable conventional hospitals. (Squires, 2018). The main features of this project are: (Wai, 2018)

•The three-block structure is arranged in a V shape that faces north, allowing winds to cross a storm water pond that sits next to the hospital.

•The three-block structure is arranged in a V shape that faces north, allowing breezes to cross a storm-water pond that lies next to the hospital.

•The building's walls were adorned with aluminum fins, sometimes known as "Wing walls," which were intended to increase the build-up of wind pressure on the façade and direct the prevailing winds inside the structure.

•Research conducted in a wind tunnel at the National University of Singapore (NUS) indicates that these fins would enhance airflow by 20–30%.

Figure 1 View of KTPH Singapore,
Source: https://www.ktph.com.sg/

3.4.2. SWEDEN'S ÖSTRA PSYCHIATRY HOSPITAL

In addition to supporting ties to nature, the building is intended to be a therapeutic space that complies with the particular security and safety requirements of a mental health center. In order to create an atmosphere that cares for all of its residents, the design takes into account the various demands of both patients and healthcare personnel. (Terrapin, 2018). The overall site area for this project was appx. 18,000 sqm and the completion year was 2006. The intention was to foster an environment free from any connections with power and force. (Lundin, n.d.) The primary biophilic patterns employed in this project include safety haven, bright, diffuse, visual connection to nature, and complexity and order.

Figure 2 Visuals of Ostra Hospital Sweden
Source: case studies https://www.terrapinbrightgreen.com/report/biophilic-design-case-studies/

Based on the application of biophilic design patterns, Table 7 compares the case studies from KTPH Singapore and OPH Sweden.

Table 7 Implementation of biometric patterns in KTPH Singapore and OPH Sweden

The way of Implementation			
Biophilic Design Pattern		**KTPH Singapore**	**Östra Psychiatry Hospital Sweden**
Nature Inside Space	Visual connection with nature	Provide a location in the welcome area that allows visitors to observe changes in the surrounding natural ecology from both within and outside the area.	There is a direct visual connection between the patients and the natural environment because every room has a view of the three gardens located in the center.
	Non-visual connection with the nature	Installing water features, like waterfalls in the center will provide visitors with both auditory and tactile stimulation derived from the natural environment.	There are courtyards with edible plants, and operable windows let in the sounds and scents of the garden.
	Non - Rhythmic Sensory Stimuli	N/A	The sounds of birds and insects, as well as the movements of the clouds, may all be perceived and felt by those living in the garden courtyards.
	Access to Thermal & Airflow Variability.	N/A	There are movable windows and sunshades in patient rooms and sunrooms.
	Presence of water	In order to create an integrated whole between the hospital and the pond, the massing is intended to open up to "embrace" the pond and "draw in" plants and water.	N/A
	Dynamic and diffused light	creating a vibrant internal atmosphere in the spacious, natural light-filled area	The interior space was naturally lit by the garden located within the building.
	Connection with natural systems	The corridor and several other areas through the courtyard are designed so that variations in the weather and natural changes can be felt.	Garden courtyards display how the weather and the seasons affect the natural world.
	tangible relationship to the natural world	Applying final touches that portray natural patterns, textures, and shapes.	birch handrails, oak hardwood floors, polished stone floors, and unpainted wood furniture
	Complexity and order	Offering a setting where people can experience a variety of sensory details about the natural world in outdoor spaces that are focused on the natural world, like green spaces and trails.	It was visible when the L-shaped pattern was repeated.

3.5. PUBLIC HEALTHCARE INFRASTRUCTURE IN INDIA

The Indian healthcare system has come a long way in the last few years. The positive overhaul of the Indian healthcare system includes a number of initiatives and advancements. Despite challenges, there are reasons to be optimistic about India's healthcare future, such as the continued investment in innovation and medical treatment. India's healthcare sector is innovating at a breakneck speed, as seen by the influx of foreign financiers and innovative medical models, cost-effective technologies, the shift from product to process innovation and the digital revolution. Prioritizing patient experiences while embracing innovation and wise investment strategies is both a collaborative problem and an opportunity. Before providing a remedy, we must search for trends in inefficiencies and failures. In the Indian context, public sector hospitals have been underrated for a long time (Raj, 2022).

The federal and state governments oversee the facilities that make up the public healthcare system. Lower-class households in both rural and urban locations can use these public facilities for free or at a reduced cost. (A. Sheeba, 2010). Public health services are provided by a network of district hospitals, primary health clinics (PHC), and community health centers (CHC). The major problem in the public sector is despite free or subsidized rate treatment public is losing trust in the public healthcare system in India which needs to be highlighted and the vitality of public sector hospitals should be increased by innovative methods. The public's interest in these outdated and poorly maintained public healthcare infrastructures is waning.

According to interviews with public health personnel, it is important to realize that, in Indian families, health care is always provided by family members, one does not visit a public hospital by themselves. The majority of the time, the patient is accompanied by an average of three to four attendees. In light of this, 300–400 people can be found in these

structures at any given moment if we discuss the 100-bed hospital. When we discuss the OPD working hours, this number increases. Because of this, the buildings lack buffer spaces or open areas where people may disperse around landscaped gardens or shaded areas, creating a congested lobby.

The case studies of Barmer District Hospital in Rajasthan and Satna District Hospital in M.P. found some observations about the public hospital designs and existing conditions. The interesting fact is that both facilities have similar kinds of observations which shows that most of the public healthcare infrastructure in India facing the same issues.

Table 8 Observations of Existing District Hospitals in Barmer District (Raj.) & Satna District (M.P.)

District Hospital, Barmer – Rajasthan and District Hospital, Satna – M.P.	
Pros	**Cons**
Located in the middle of the city	No management of traffic on entry-exit gates
Open campus with courtyard	Open campus with less available space for any further addition
Easily approachable	Despite having courtyard planning lack of natural light inside the building.
The old but strong load-bearing structure	Long corridors without any outdoor visual connection make it a tunnel effect.
Accessibility for all inside the building.	Bigger size of general wards without any proper ventilation and Sunlight.
The facility of clean drinking water.	No sensation of space and location, nor any direct or indirect relationship to nature.
-	Lack of greenery/ landscaping inside the campus
-	Lack of cleaning and sanitation in some parts.

Images in Figure 3, shows that long corridors without any natural light and ventilation creates an effect of a long tunnel. Where ventilation openings are present, those are not sufficient to provide an outside view to patients. The walls of the corridors and wards have dull and blank finishes which can be turned into walls that can create indirect experiences for the patients applying biophilic design principles.

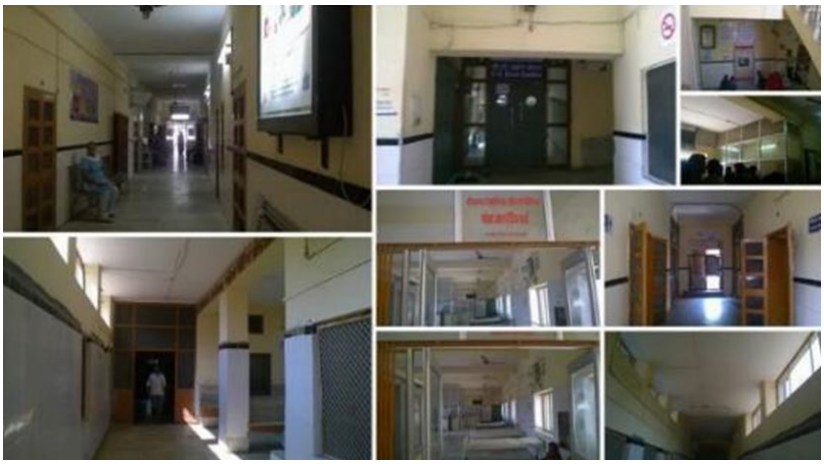


Figure 3 Existing condition of District Hospital Barmer - Rajasthan

Source: Author

Images in Figure 4, show long corridors with proper openings for ventilation and natural light. Even these hallways provide a clear visual link to the natural surroundings, but In Satna district hospital lacks a natural environment on campus as no maintained green spaces are available nor any waterbodies are available. Wards and waiting areas still feel like a jail as structures are old and lacks any type of biophilic patterns as mentioned above literature study.

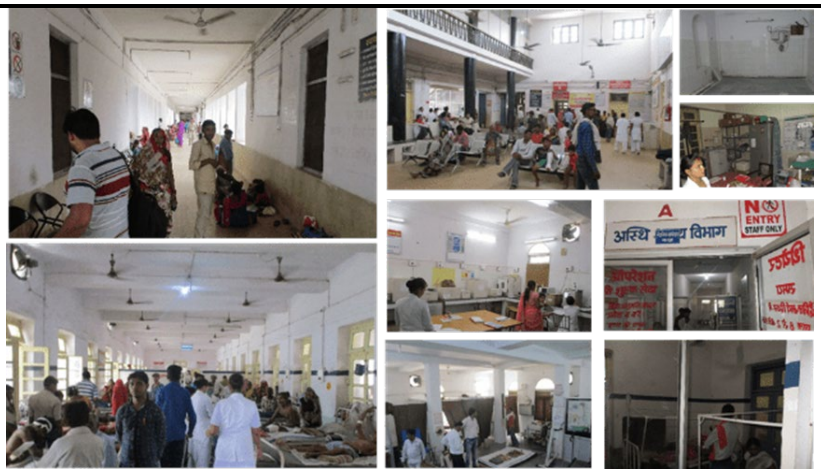


Figure 4 Existing condition of District Hospital Satna,
Source: Author

3.6. CRITERIA FOR SELECTING THE CASE STUDIES

Table 9 shows a comparative analysis of biophilic parameters between International healthcare facilities and Indian public healthcare facilities, which shows that Indian public healthcare facilities have so much scope for improvement by considering the parameters of biophilic principles as incorporated by international hospitals.

Table 9 Criteria for selection of case studies

Biophilic parameters	**KTPH Singapore**	**Östra Psychiatry Hospital Sweden**	**District Hospital Barmer - Rajasthan**	**District Hospital Satna – M.P.**
Nature in the Space				
Visual Link to the Natural World	✓	✓	✓	×
Non-visual link to the natural world	✓	✓	×	×
Non - rhythmic stimuli	×	✓	×	×
Thermal and airflow variability accessibility	×	✓	✓	✓
The existence of water	✓	×	×	×
luminous and diffuse	✓	✓	×	×
Relationship to natural systems	✓	✓	×	×
Natural Analogues				
Patterns and forms of bio morphism	✓	×	×	×
tangible relationship to the natural world	✓	✓	✓	×
Order and Complexity	✓	✓	×	×
Nature of Space				
Potential	✓	✓	×	×
Safety	✓	✓	×	×
Mystery	×	×	×	×

Risk or peril	×	×	×	✓
Percentage of biophilic acceptance	71.42	71.42	21.42	14.28

4. RESULTS

The literature was studied and reviewed to identify the factors that can enhance the feasibility of a building concerning biophilic design parameters and to create a link between the user of a building focusing on a healthcare building and the surrounding nature or natural elements. The study shows that experiences with nature help to control different human emotions inside a building. In the healthcare sector, it has already been justified that human experience with nature helps in the healing of patients and also helps in the mental well-being of the staff and other users. While many healthcare facilities across the world are already incorporating biophilic design ideas into their structures, public healthcare facilities in India are primarily constructed to house the limited functions of a hospital. The structure is not patient-friendly neither they have any connection with any natural elements. In some cases, the provision of natural light and ventilation also lacking which is a very basic principle of a biophilic design approach.

5. DISCUSSION

The literature was studied and reviewed to identify the factors that can enhance the feasibility of a building concerning biophilic design parameters and to create a link between the user of a building focusing on a healthcare building and the surrounding nature or natural elements. The study shows that experiences with nature help to control different human emotions inside a building. In the healthcare sector, it has already been justified that human experience with nature helps in the healing of patients and also helps in the mental well-being of the staff and other users. While many healthcare facilities across the world are already incorporating biophilic design ideas into their structures, public healthcare facilities in India are primarily constructed to house the limited functions of a hospital. The structure is not patient-friendly neither they have any connection with any natural elements. In some cases, the provision of natural light and ventilation also lacking which is a very basic principle of a biophilic design approach. This paper focuses on two major things, one is Biophilic Design and another one is Public health infrastructure in India. In the present time, both have no relation at all, but if as an architect we can combine them, it can change the overall perspective of a society towards the public services provided by the government for its people. As per this research findings, Indian public healthcare facilities lack very basic experiences like direct experience with nature. Most of the buildings lack natural lighting and proper ventilation inside the building. They do not have a good vision of the surroundings outside, which somehow creates an atmosphere that lacks positivity in the surroundings. Research findings also show that public hospitals are just meant to provide a functional space, not a living space, which is why the patient who comes for the treatment feels like jail and is only dependent on medicines and lacks natural experiences for healing like direct or indirect experiences of nature. This is the major cause of lacking interest in treatment from public healthcare facilities compared to privet healthcare facilities. But as the treatment in private facilities is comparatively expensive, it becomes the responsibility of everyone to get better treatment less expensively by enhancing the vitality of public healthcare infrastructure in India. One other factor covering the staff of these institutions is that most of these institutions are doctors or surgeons-centric as they are at the top of the hierarchy of the system. But we have to understand that other staff like nurses, technicians, support staff, cleaners etc., lack proper space to rest and work day and night and no one is talking about their mental health. Adding biophilic elements will improve their ability to unwind and create a positive environment in which they can give their all to the facility or the patients, who rely heavily on them.

6. CONCLUSION

Concluding this research there is good scope for renovating existing public healthcare infrastructure through the use of biophilic ideas to make these structures gain the confidence of its users and can change their perspective towards public building. Implementing this design idea in a single project can make it ideal for reviving other public infrastructures too. Additionally, medical scams in the private sector can be decreased by winning back the trust of public sector customers.

7. RECOMMENDATIONS

As a participant in the architectural fraternity of India, we can suggest some redevelopment proposals to the government to enhance the feasibility of these public healthcare buildings by using biophilic design principles by conducting large-scale primary surveys to understand the needs of users and encourage them to use the public facilities which are meant for them only.

CONFLICT OF INTERESTS

None.

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None.

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