

ROLE OF ARCHITECTURE SPACES IN CONTROLLING INFECTIOUS DISEASE: A CASE OF COVID-19 MANAGEMENT IN LAHORE, PAKISTAN

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ABSTRACT

Covid 19 had a great impact on the lives of people all over the world, while it had many serious implications, one of the most important ones was the quarantine and the isolation that came with it (Ferreira, et al., 2022). With this, the world came to learn the importance of the built environment and how its quality impacted not just the quality of life in the quarantine but also the management of the disease. This research examines the impact of architectural spaces on the management of COVID-19, it is done through a comparative analysis of the Expo Center Lahore and the Pakistan Kidney and Liver Institute (PKLI) as they both were converted into a COVID-19 quarantine center during the COVID-19 pandemic. This Research is based on qualitative data and analysis through two means, first is the analysis of architectural spaces done through observations and architectural drawings. Second is the interviews of patients who stayed in these quarantine centers and the interviews of staff who managed them. The analysis included functional aspects of design, disease control, artificially adopted healthcare, and social characteristics as external variables that predict patient satisfaction levels during quarantine. Results showed that the sense of privacy, mental health, isolation, and patient and staff safety regarding infectious diseases are the most important features defining the success of these centers. Research also indicated the need to review the infectious disease healthcare regulation on healthcare by-laws.

Keywords: Covid19, Patient Satisfaction, Quarantine Isolation, Built Environment

INTRODUCTION

COVID-19 is a global disease, it has shown that a pandemic can occur at any time with adverse effects on human health, bringing the whole world to a halt. It also showed that architecture can help to reduce the risk. Developing countries like Pakistan faced many problems in fighting the pandemic because of the lack of a proper healthcare-built environment (Frumkin, 2021). Creating a healthcare space that supports a positive environment and creates a space for patients' physical and mental health requires a lot of considerations. This study will try to understand these requirements and explore how these are incorporated in the two buildings under study. It includes naturally ventilated spaces, natural light, appropriate building materials, biophilic design, and some other characteristics that will be discussed in the literature review (Megahed, & Ghoneim, 2020). This research examines the artificial emergency healthcare unit's development by the government

bodies in COVID-19, and how efficiently these spaces performed. The main problem discussed in this research paper is how to transform the general building or a general hospital into a center that fits the layout of the infectious disease hospital, which can accommodate highly infectious patients, and solve the bed shortage issue during a pandemic. The paper also discusses how healthcare organizations need to give rise to protocols for risk control and patient safety in quarantine settings. In particular, during the pandemic, the healthcare staff needs to know the patient behavior and healthcare protocols in line with the best practices for COVID-19 control. Ultimately, this study gives a prescriptive model to shape the built healthcare environment to make it healthier and more resilient to the pandemic and to reimagine how artificial healthcare spaces can function and operate better.

Literature Review

Before Covid-19 the world suffered from many pandemics including the first cholera pandemic 1817, the Russian flu 1889 (Smith, 1995) the Spanish flu 1918, and HIV & Aids 1981 (Kevin, 2008). However, COVID-19 created a different impact on the building environment and on human psychology. The public authority's order to remain inside homes because of the Coronavirus pandemic and individuals' apprehension about leaving have raised the worth of homes from more than a space to live (Aresta & Salingaros, 2021). Some countries created a more isolated approach to managing quarantine patients, like China's strategy of Hospitals at Home (HaH) which proved to be successful (Coloma & Nicolás, 2020). Where homes lacked the necessary facilities and requirements, quarantine centers became necessary. The quality and effectiveness of these quarantine centers varied greatly and were dependent on a number of factors. Wang et al (2021) claimed that the location of a temporary hospital and quarantine center is one of the most important factors for its effectiveness. Campos et al. (2022) described, that the effectiveness of a quarantine center or temporary hospital was largely dependent on their ability to prevent cross-contamination and provide suitable care. Candel et al. (2021) argue that hospitals that guaranteed the social and emotional needs of patients were working successfully which depended on the proportion of patients who may require critical care. Many other researchers also stressed the importance of mental health for the effective healing of patients (Pfefferbaum, & North, 2020).

Covid-19 and Mental Health

A large number of patients and paramedical staff physically and mentally suffer from Covid 19 (Amin, 2020). People who are much busier in their social lives are quarantined and face the pandemic with psychological fear, tension, and isolation (Talevi et al., 2020). Individuals who were affected by the virus were facing the fear of going to hospitals and those who were admitted to hospitals were facing a new environment of quarantine and isolated without any family member or caregiver. The conventional hospital design approach was not good enough to fight infectious disease COVID-19 (Nicolás 2021). Artificially transformed healthcare units were facing a lack of medical environments which also created different problems for the patients and government bodies.

Cities and COVID-19

Covid-19 had a huge impact on cities, it completely changed the lens through which we see our cities in the current world (Boyko & Cooper, 2024). There are many factors and aspects associated with COVID-19 that affect human life in cities, however, the most highlighted and discussed factor is urban density (Joiner et al., 2024). It highlighted how the highly dense urban areas became a hotbed for the spread of infectious disease and long before the authorities could understand what was going on and could respond to it, the whole situation was out of hand. However, the reported evidence on the association between density and COVID-19 is still contrasting and inconclusive (Khavarian-Garmsir, 2021). Research indicates that there are many other factors at play, like exposure, sensitivity, and the adaptive capacity of cities (Teller, 2021). Even though the practicalities of social distancing in the cities are associated with population density, research still concludes that the designers will have to keep on making dense cities because the cost of not doing so is too much and it would not be practical (Carozzi, 2020). So, the burden of the prevention of the infectious disease lies on the architectural environment. The built environment creates room for the social environment, and through maneuvering the built spaces designers can achieve social coherence in normal times and social distancing in the times of a pandemic (Lai et al., 2020). This becomes particularly important in the healthcare designs of the buildings.

Lack of Medical Facilities in Pakistan

In Pakistan, the healthcare design of the buildings is often not up to the mark (Kurji et al., 2016). There is no central management of all hospitals and healthcare buildings and that is why the healthcare system is very segmented. Being a developing country, it has always struggled with good quality healthcare, especially in the remote areas of the country (Kurji et al., 2016). This lack of proper management and quality of healthcare became even more evident during the pandemic. The first two COVID-19 cases were recorded in Pakistan's cities of Karachi and Islamabad on 26th February 2020, as it was announced by the Federal Health Minister. After this, the cases started growing exponentially and soon COVID-19 took over the whole country (Waris et al., 2020). The epicenter of the pandemic "China" borders Pakistan, and on the other side Iran

was also seeing a huge surge in cases, so it was inevitable that the cases would enter Pakistan from all sides, and that is why the government needed high influential policies not just for controlling the cases but also to isolate the people being affected by the pandemic so that the rest of population can be protected (Noreen et al., 2020). World Health Organization also advised the countries to take all precautions to control the spread of the disease, they were advised to take preventive measures to limit the transmission of the virus through continuous surveillance, quarantine, awareness campaigns, and early detection.

An added issue was that at the beginning of the pandemic, Pakistan did not even have a testing system for checking the suspected patients and their samples were sent to China, so the results would take a lot of time (Khalid & Ali, 2020). This added to the difficulty of isolating such patients from the rest of the population. In addition, only a few specific quarantine centers with limited diagnostic and treatment facilities were present until the government received primers, test kits, and equipment from other countries. As of 27 June 2020, many test centers were available in Pakistan, and the World Health Organization (WHO) also provided support in this matter. Availability of other supporting equipment, even as simple as masks became an issue. Many drugs that people were taking to fight the symptoms of the disease became scarce. At the time government implemented this strategy that all suspected and confirmed cases should be kept in the quarantine centers because they cannot be allowed to quarantine in their homes (Memon et al., 2021). But there weren't enough beds available in the already existing healthcare system. At the time of this study which was in January 2022, the pandemic was still going on, and the statistics of the patient and available beds were not good. Karachi, Lahore, and South Sindh, which accounted for more than 70,000 of the country's 98,000 cases, just had 14,000 beds including both private and government hospitals. Dozens of patients contacted hospital administrations, but due to a lack of medical facilities, hospitals were unable to provide adequate medical assistance. Quarantine centers lacked standard care and a screening process (Nafees & Khan, 2020).

As cases of COVID-19 surged in Pakistan, hospitals were falling under the weight of patients. Nurses were stressed, laboratory equipment was strained,

and emergency rooms were overflowing with infected patients. Likewise, the labor force was decreasing, ICU space was running out, and the cost of care was rising. Basic medical equipment was also non-functional and doctors and medical staff were missing. No specialized training was provided to healthcare workers regarding the pandemic. Expensive medical equipment remained inoperable for years (Imran et al., 2021). The elite class received preferential treatment and the poverty-stricken were left behind. Maintenance and repairs of medical facilities were also ignored. Additionally, it was not uncommon to witness scenes of the general public smashing hospital facilities. The grief over the death of their loved ones turned into pandemonium because it was only a "doctor's mistake", this situation had serious implications for the medical health of staff (Rana et al., 2020).

In this scenario, it was a requirement of the time to set up new quarantine centers with more beds and adequate facilities. This is why the government took over big buildings like the Expo Center and PKLI (Pakistan Liver and Kidney Institution), however, the effectiveness of the operation in these buildings was still questionable.

Three Zones of Healthcare

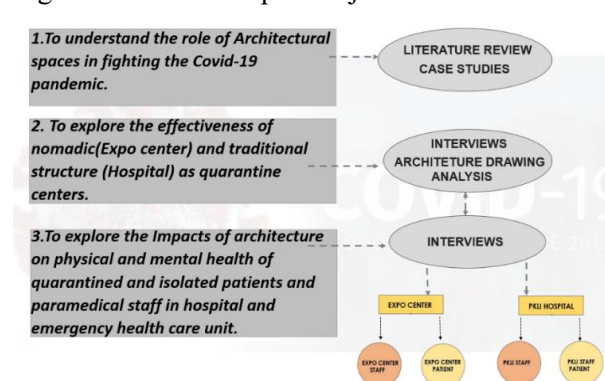
To make the healthcare buildings more efficient and to operate them on international standards, The Government of Pakistan provided zoning bylaws which were based on a color system including green, yellow, and red (Government, 2020). The Green Zone is the clean area, any patients who have been tested and found negative for Covid-19 were kept in this zone. These areas are cleaned and maintained according to routine methods and no specific cleaning methods were required. The movement of people in the health facility, in general, shall follow the principle of "three zones and two passages": a contaminated zone, a potentially contaminated zone, a clean zone provided and clearly demarcated, and two buffer zones between the contaminated zone and the potentially contaminated zone. The Yellow Zone is the Potentially Contaminated Area. This Zone included patients that were still to be tested so there was a potential that they might be containing the disease. Outpatient testing centers are to be set up in this zone. Everyone entering the hospital is required to wear a mask and they must use hand sanitizers or wash hands upon entering or leaving this zone. Medical personnel are required to put on their

protective equipment while entering this zone and take it off while leaving. Infection prevention and control technicians shall be assigned to supervise the medical personnel in putting on and removing protective equipment so as to prevent contamination. Red Zone is the Contaminated Area, it contains the isolation wards, ICUs, and operating rooms. The building layout and workflow shall meet the relevant requirements of the hospital isolation technical regulations. Medical providers with negative pressure rooms shall implement standardized management in accordance with relevant requirements. Access to isolation wards shall be strictly limited. There is a requirement of putting the beds at a certain distance, that is 1.2 meters (appx 4 feet) to control the intermixing of patients, all rooms should be provided with bathrooms so that patients do not have to leave the room. A buffer room must be created between the red zone and the rest of the building to stop the airborne infection; this room shall be tightly closed.

Research Methodology

There are three objectives in this study. The first one is to understand the role of architectural spaces in fighting the COVID -19 pandemic that is done through the literature review. The second is to explore the effectiveness of the Expo Center and Designed Kidney Special Hospital as a quarantine center. The third one is to explore the impacts of architecture on the physical and mental health of quarantined and isolated patients and paramedical staff in hospital and emergency health care units. Second and third objectives will be achieved through two qualitative methods. First is the study of the architectural spaces through plans and through observations by visiting these spaces, and second is the semi-structured interviews. Figure 1 shows the relationship of objectives and methodology.

Figure 1: Relationship of Objectives and



Methodology

To achieve these objectives two buildings were selected, the Expo Center Lahore and the Pakistan Kidney and Liver Institute (PKLI). Reasons for the selection of these two buildings is that the first one was originally an exhibition space that was turned into a quarantine center for the management of Covid-19. And the second building is a purpose-built hospital building but it wasn't particularly designed for infectious disease control. Both buildings had their own unique challenges when it came to the management of COVID-19.

Semi-structured Interviews were conducted with two kinds of people. 1st is the patients, which includes detailed interviews of COVID-19 recovered patients with reference to personal information, social satisfaction, functional satisfaction, spatial satisfaction, and contextual satisfaction of hospital and emergency health care unit design and its impact on human health. The second source of interviews is staff working in the healthcare care facilities, it includes detailed interviews of COVID-19 paramedical staff with reference to hospital architecture and emergency healthcare unit. 10 interviews are conducted with patients and staff each. These interviews are transcribed from audio to written data, and then it is coded using NVivo 11. The process of coding and outcomes are shared in the results. Figure 2 shows different parts of the research and their connection leading to the final research outcomes. The results of this analysis will be used to develop guidelines for future planning of healthcare facilities, and all other large-scale public-sector buildings.

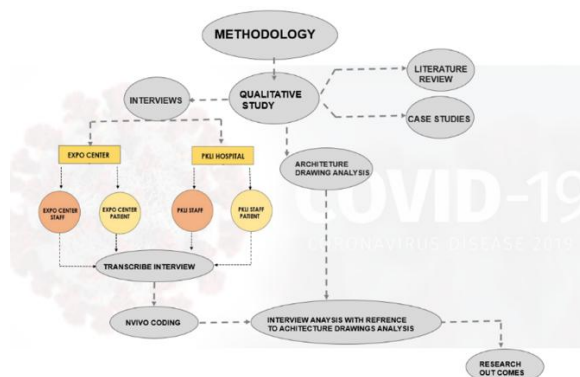


Figure 1: Research Framework

Findings and Analysis

Architectural Comparison of Kidney Special Hospital and Expo Center

The selected buildings (PKLI and Expo Center) were studied for three factors. The first is to examine how to control infectious disease in healthcare units concerning its visitors, patients, and paramedical staff flow design during the pandemic. The second is to understand the impact of planned hospitals and artificially adopted healthcare units Expo Center on patients psychologically and physically. Also, to understand the practical differences between the two types of quarantine spaces, and which of them has been more successful and effective in catering to the needs of Covid Patients.

Zoning

In the PKLI There are four major building blocks which are placed east-west long side-oriented, the quarantine Centre is placed on the eastern side of the site. The access for this center is from North East gate 1 and 2, emergency west faced and gives access from west gate 4, all four building blocks are placed in the centered area and at the lower side of the site. The designer placed the mosque accessible from all blocks. The central block is the emergency and diagnostic Centre. The right-side building block is reserved for the quarantine Centre entrance. PKLI zoned well due to the functionality of space as three major building blocks connected with roads. Each separate block and very right-side chunk designated for the quarantine center have separate access.

The Expo Center zoned interlined 4 prefabricated halls which are used for normal functionality of the expo center, while working as a quarantine center single entrance meant that everyone coming in site can mix up making it very difficult for the management to control movement. All 4 halls are placed around the auditorium in a semi-circle shape which gives importance and focus to the auditorium complex. All four halls have entrances from the auditorium side and also from the main road which is connected from gate 4. On the south side and on the lower right downside public bathroom and mosque are placed that are detached from the main building (Figure 3).

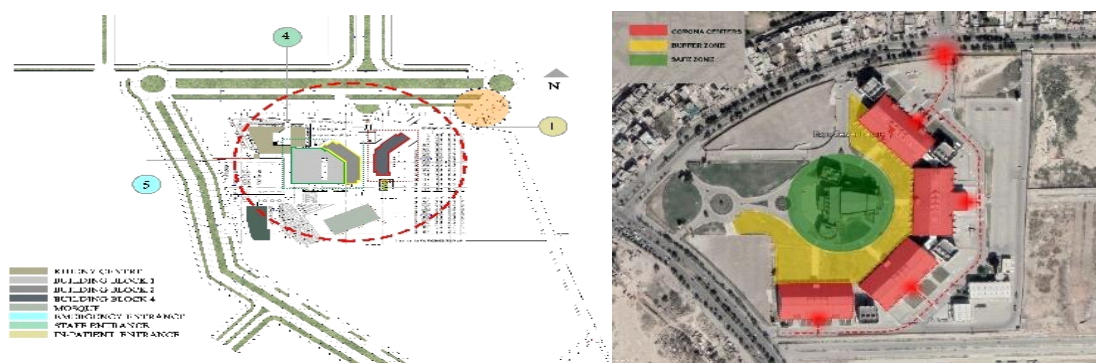


Figure 2: Site Zoning of PKLI on left, Site Zoning of Expo Center on right

Master Planning

The master plan of PKLI is a more practical and functional design that has 5 gates for entry and exit. Total 4 building blocks also with mosque and energy unit including huge green spaces and maximum car parking for all blocks.

The Expo Center is a public events complex and artificial center created for COVID-19 patients, it is a complex of four steel-structured halls that are used for the quarantine center along with an auditorium complex. The positive thing is that it has a huge parking facility.

Architectural Design

PKLI is a professional hospital in which space design is very well planned according to its function in which every floor works efficiently. The architecture of this building is on contemporary lines. It is a purpose-built hospital designed with a modern interior and exterior design approach. Its facade décor is done with gutka, which is very famous in Lahore in commercial buildings.

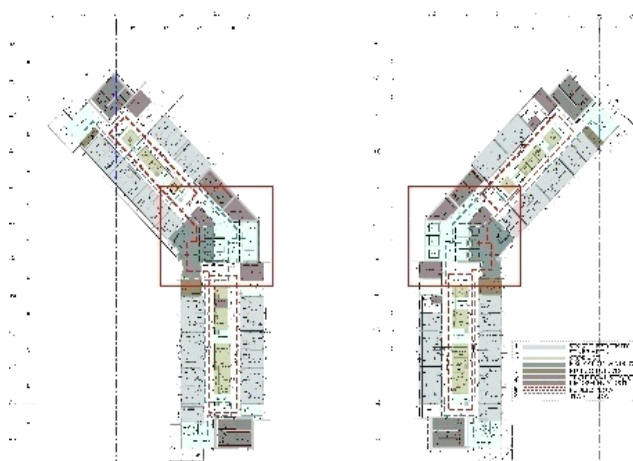
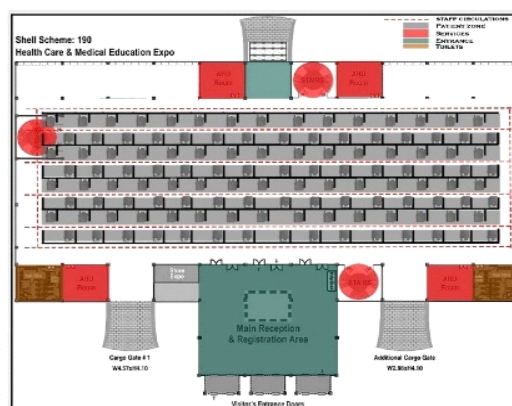


Figure 3: Typical Floor plan of PKLI on left, Expo Center on right



The Expo center has open halls with double heights that is open and not very suitable for work as a quarantine center, making it poor for this purpose (Figure 4). It is a huge structure with dead walls. The Expo Center is a public event building and it was very difficult to convert it into a quarantine center for the accommodation of COVID-19 patients. Because of different building functions, it did not fulfill the whole requirements set which is necessary for the quarantine Centre.

Interior Design

PKLI has well-designed suites such as single-bed units that is suitable for covid-19 patients. They are properly lit and ventilated by windows in every room. This provides the patient with the opportunity to stay connected with the outdoor environment. PKLI interior design is very calm and healthy for patients because of its purpose-built design so every space is designed according to its own function. Expo halls have open plans with huge structures that give very bold feel but these halls do not have any punctures in walls for view which is very important for patients. Because the expo center is a public events building and its interior is designed for large gatherings. The halls that were used for the quarantine center were totally open with no ceiling that gave an industrial look. Its structural elements were showing and there was no connection with the outer atmosphere.

Biophilic Design

PKLI has green areas and all blocks are surrounded by green patches, all of them have open-to-sky

spaces and patios in design for the incorporation of biophilic design for patient good health and fast recovery. In the layout plan, all beds are placed at the edges of the building block for view and ventilation purposes. Other than the patient area PKLI is well landscaped in the right places, which can be captured from different windows and the patient could stay in touch with nature.

The Expo Center has a prefabricated structure which has a totally different purpose of building so that is why patients don't have any kind of experience from outside and from the sky above. In these exhibition halls, patients did not have any simple puncture to ventilate naturally, this was a big drawback of design that patients were not in relation with nature.

Functionality

PKLI is a purpose-built functional hospital and although it was not designed as a quarantine center to manage infectious diseases its design was not difficult to transform it into a quarantine center. The Expo Center is designed to accommodate large

exhibition spaces, so its functionality contradicts the functional requirement of a quarantine center.

Accessibility

Access to PKLI is connected with Avenue 5 Main Boulevard and Rao Ave Road. The COVID-19 quarantine ward building which is block 2-4 has special access from gate 1.

In the expo center, the main access to the site is from Abdul Haque Road and the building for COVID-19 quarantine ward access is from gate 3 which is near quarantine Centre halls. In terms of accessibility, both places functioned well.

Internal Planning

Because PKLI is a hospital all of its major services are accommodated in the basement. On the ground floor designer set up the Out Patient Department, Diagnostic Centre, and emergency, on the first floor there are maximum examination rooms second floor is the operation theater complex, and from the 5th to 9th floors are all single bedrooms. With proper natural ventilation and open-to-sky spaces.

The Expo center is an event-based space with large halls, so all quarantine centers settled in halls in which bed rows were made by maintaining 3-meter distancing. There is no outer view for every single bed, and no central space for ventilation is installed in the steel-fabricated structure.

User Comfort

PKLI has all allied services and basic needs for patients that are compulsory during the quarantine period.

It is a function base design for the hospital so it is equipped with each and every facility for patients and staff. In the I.P.D block, every bed has windows and attached bathrooms.

The Expo Center lacks services as compared to PKLI because it was a temporary quarantine center. The patient faces different issues related to toilets, ventilation, circulation, and others.

Routes

In PKLI routes are defined and circulation is very limited to visitors and patients. Staff and other

technical spaces are restricted by design elements and locked doors. Especially in quarantine centers where the patient has their own single bed and attached baths, so patients have very limited flow and routes in quarantine centers.

In the expo center because patient beds are placed in big halls that's why circulation is open and there is restriction on just staff and technical area. Other than this all halls were accessible for patients and visitors which is not good practice. The toilets were also far away from the patient's bed which is why the flow was very random and chaotic.

Interviews

The interview questions are based on the objectives of the research, these questions are explained in Table 1. This table contains different categories of questions, detailed questions under each category, and its link to the literature. Questions were aimed to understand the experience of people living in these quarantine centers and how in their opinion it has helped or hindered their healing process. Questions were meant to generate discussion and interviewees were given the chance to lead the conversation so that the issues that are important for them can be highlighted. These interviews were recorded and transcribed creating different Word files.

NVivo 11 Coding

The Word files of interviews are added in NVivo 11 for analysis. There were multiple questions and multiple answers from different interviews in NVivo. Upon selection of 1 question its answer by all respondents is added into 1 code, this method was continued till all interviews were coded. In these codes, the questions that created the most rich responses showed that these questions and the issues they were discussing were important for the interviewees. These responses will be shared and discussed in the sections below. The examples of interviewees' responses along with their relation with the built environment are also discussed in the sections below through figures number 6, 8, 10, and 12. The text inside the boxes in these figures are direct quotations from interviews.

Concepts to be Explored	Questions in the Interviews
Hospital Zoning (Yellow, Green, Red)	Do you think the Hospital Environment controlled Infectious Diseases?
	Is there any separate dirty and clean zone in PKLI and expo center?
	Do you think that hospital design should improve regarding infectious disease environment?
	Was there any zoning of infectious and disinfections patients?
	Did PKLI and Expo center play its role in controlling the spread of the disease?
	Was quarantine space isolated well?
Lock Down and Covid -19	PKLI and Expo Center environment are affected your mental health?
	How Do you Feel in PKLI and Expo center During Covid 19?
	Were there proper green spaces and refreshing environment?
	Did you feel Safe in Isolation center?
	Did isolation affect your mental health?
	Was hospital staff friendly and co-operative?
Biophilic Approach	Quarantine Center fulfill the medical requirements?
	Do you think well designed isolation area can help to encourage the patient to get better soon?
	Do you want some landscape area in hospital environment to spend time?
	Do you think that hospital design should improve regarding infectious disease environment?
	Do the isolation wards have friendly environment?
	What do you think about adding some green space in the hospital environment?
Domestic Space Design and Covid 19	Did you to prefer to go hospital during Covid 19 or treat it in home?
	Does Patients Feel Comfortable in home or Hospital?
Psychological impact of Covid 19	Does medical staff affected by covid-19?
	Does patient behave mental abnormality during isolation?
	Did patient feel safe in PKLI and expo center?
Separate Emergency Space	What do you think about a separate facility or emergency area within the hospital for dealing infectious diseases specially?
	In your opinion is there a need of a separate emergency ward in the hospital for infectious diseases?
	Did you feel anxious in hospital environment during covid-19?

Table 1: All interview questions and their central concept

Expo Center Patients' Interviews Analysis

The patient interviews analysis from the expo center showed that most patients responded to questions about the feelings associated with staying at this quarantine center. The majority of people responded to this question that they are not satisfied with the quality of their stay at this quarantine center and they were not feeling well in this place. The second most answered question was also about patients' feelings but this time related to the fear and anxiety attached to being a Covid-19 patient. Responses to all the questions are not shared here because of lack of

space. However, a lot of questions that generated discussion were linked to the quality of services at the expo center. Patients identified that they don't feel good in this space because they have no privacy. There is no connection with the outdoor environment and no natural light or ventilation. The most important thing that almost all patients identified was that they have absolutely nothing to do, there is no activity to keep them busy. Figure 5 provides a detailed analysis of patients' responses and their relationship with the quarantine spaces of the expo center.

EXPO CENTER PATIENTS INTERVIEW ANALYSIS

EXPO CENTER ARCHITECTURAL ISSUES

FEELING IN EXPO CENTER

PATIENTS CAN NOT FEEL GOOD IN EXPO CENTER

- I felt worried. Because the scale of roof height and overall atmosphere of quarantine Centre is creating a very bad experience to patient which give a not positive response to our recovery rate.
- I felt worried because of there is no view inside the isolation center and there is huge steel structure which is partially used for emergency pandemic isolation center due to don't have hospital like these pandemics.
- I was satisfied but some issues make more better this isolation center like well zoned according to health ministry of Pakistan with respect to covid-19
- I felt very disturbed and stressed. Because every patient in different stage of covid-19 which make patient very weak and disturbed and because expo quarantine Centre is open bed plan that's why patient have any view to beautiful green window in front of his or her rather than patient have to look same condition person or in dangerous stage.

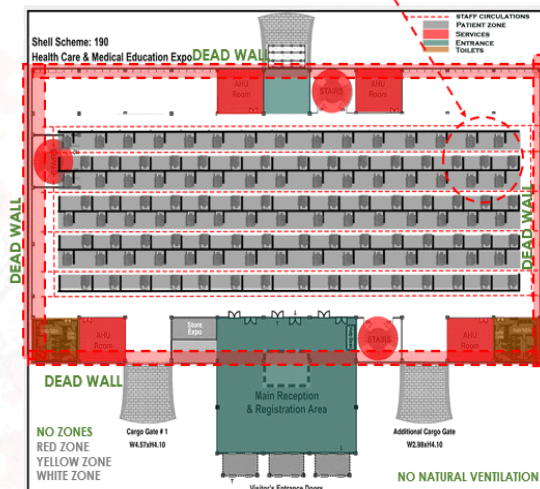
SEPARATE SPACE IN HOSPITAL

REQUIRED SEPARATE SPACE IN EXIST MEDICAL FACILITIES

- Yes, there should be a separate facility for dealing with the infectious diseases. Areas like grounds and open areas should be converted into centers to deal with the infectious disease.
- Yes, there should be emergency areas within the hospitals to deal with the infectious diseases. Because this is very rare and vital pandemic in world which have very long lasting and dangerous effects
- Yes, there should be emergency areas within the hospitals to deal with the infectious diseases. Because of help to fight for this kind of pandemic we need very high standard of setup to prevent the more percentage of death rate from this pandemic.

PATIENT FACE A DIFFERENT TYPES OF ISSUES RELATED TO SPACES AND MANAGEMENT

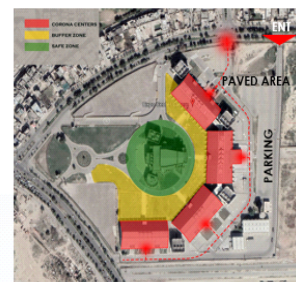
- No privacy in expo centre because large no of beds are arranged in one hall which facing each other its big flow in space design people cant not feel comfortable during quarantine.
- Bath room not design according to patients requirements.
- No ventilation in expo centre hall which high required for covid -19 patients.
- Massive steel structure create a darkness and eco in hall which affect the patients health.
- No zones define in expo centre which is required of covid hospital red yellow and white zone.
- Mostly patients dead in front of covid patients which also create a stressful environment in hall.



EXPO CENTER ENVIRONMENT AFFECTS ON MENTAL HEALTH

EXPO CENTER ENVIRONMENT AFFECTS THE PATIENTS MENTAL HEALTH DURING QUARANTINE

- Due to dead walls and full closed roof (patient 1)
- Expo center design is not well for this kind of pandemics that why these all constrains making patient more worried (patient 2)
- Yes, it made me depressed. Because of its broader scale and large heighted roof which tend to create more fear for patient (patient 3)
- Yes, it makes you anxious and stressful. Because when a severe patient added in a space which is already full packed and dark which have no natural ventilation and views from inside to outside like hospitals which is tend to make patient more stressful and hopeless. (patient 4)
- Yes, you become lonely and introvert. Because every bed has their own territory with no window and all three sides are blanks and one side open which is also use for circulation purpose in quarantine center. (patient 5)
- Large number of patients are dead in front of patient which create more stress in patient which I feel I can not survived more because mostly people due to this infection. (patient 6)



LANDSCAPING IN EXPO CENTER

GREEN SPACE CAN NOT CONNECTED WITH QUARANTINE CENTER

- Yes, there should be green spaces. But these all spaces are not connected with quarantine Centre which is not proper efficient. Landscape is an element which have directly impact on patient mental physic.
- Yes, there must be some green areas but these green areas are not fruitful for this pandemic and this isolation center which is temporary opened in expo center Lahore because the zoning of green and brown patched take places on initial level of project which is not implement as start because of function of expo center is different

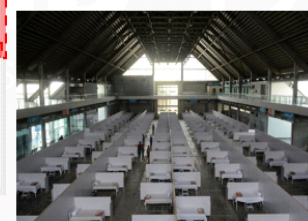


Figure 5: Patients' response to the interview questions and their relationship with the built environment

Expo Center Staff Interview Analysis

In the second round, the interviews were conducted with the staff working at the expo center. The question that generated the most rich response is "Does the expo center provide a friendly environment to the patients? Most interviewed staff members responded positively to the question that the expo center feels like a friendly environment for a quarantine center but when the same question was asked to the patients, they gave the opposite response. Patients mostly responded that the expo center is not a friendly environment for a quarantine center in COVID-19. In the next question, however, they responded that the time spent in a properly designed hospital is much more helpful for the patients for a full recovery as compared to the expo

center. The staff mentioned that the expo center management is not very helpful to the staff and that is why it is difficult for them to provide the best facilities for the patients. A very important issue highlighted in these interviews was that staff responded that there are no dirty or clean zones identified in the expo center and the whole center is working without this very basic requirement for quarantine centers by the government. Upon asking about the mental health of the patients, staff agreed that this quarantine center is not a good space for patients' mental health and there are no proper experts who can look after this issue. Figure 6 provides a detailed analysis of staff's responses and their relationship with the built environment.

EXPO CENTER STAFF ANALYSIS

FEELING IN EXPO CENTER

STAFF CAN NOT FEEL GOOD IN EXPO CENTER

- No. because of there is different routine life you have to still at one space you can't move anywhere just you allow to go toilet in case of you have to need to use otherwise you remain still at wooden bed with no proper furnished sheets which is not properly patient bed.
- yes, it was partially friendly not completely because there is no experience to every person bed and also there is hot climate in quarantine center because of steel structure which is directly conductor to sun which is on peak during June July month.
- Environment felt stressed. Because of their restricted environment due to infection spreading, you have to stay at same space without any moment at anywhere so I felt depressed by staying at a space.
- yes, but I feel also depressing at different stages like when new person admitted in quarantine Centre. I feel so hopeless to release for this quarantine center.

SEPARATE SPACE IN HOSPITAL

REQUIRED SEPARATE SPACE IN EXIST MEDICAL FACILITIES

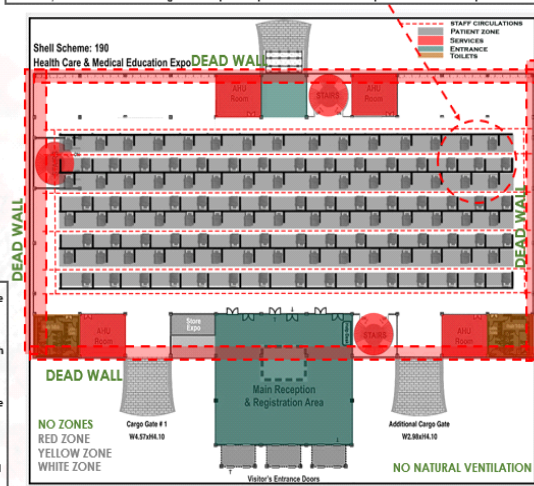
- yes, there should be separate facility for such purpose rather than making them within the hospital. Because this kind of patient need special attention and care from staff point of view.
- yes, there should be a separate facility for dealing with the infectious diseases. Because in this pandemic we have fear to spread from one person to another that's why we need to separate facility for this pandemic.
- yes, there should be separate facility for such purpose rather than making them within the hospital. Because hospital take patient on regular basis which got make be effected for this virus. And the number of patients also reduced which come for normal checkup.
- yes, there should be area designed within the hospital because it has more equipment and facilities.



EXPO CENTER ARCHITECTURAL ISSUES

FACE A DIFFERENT TYPES OF ISSUES RELATED TO SPACES AND MANAGEMENT.

- yes, there must be separate zones which make more progress in sense of controlling to spread of covid-19 infection.
- yes, there should be separate rooms or proper partitions to avoid any possibility of contact. And those rooms should be proper ventilated.
- Yes, there should be well designed spaces. Because well designed spaces for patient make progressive quarantine Centre in which patient recovery speed is very high.
- Yes, it should. Because in well-designed hospital or quarantine Centre for this kind of pandemic we find biohazard I design which is necessary to create healing in environment for patient specially.
- Yes, it should. because design have impact on patient mind which is depressed in case of expo Centre.



QUARANTINE CENTER SUPPORT MEDICAL STAFF

QUARANTINE CENTER SUPPORT MEDICAL STAFF DURING COVID 19

- yes, they supported and provided them with food and kits. But these all facilities and amenities is incomplete and with this kind of services every person which is staff of quarantine Centre not entertained.
- No. even many staff person not have their kit to wearing during their duty for prevention from this pandemic therefore a staff person got infected from this pandemic.
- yes, they supported and provided them with food and kits.
- yes quiet. But given kits and other things are firstly not compete properly and if they are complete hen every person no entertained with this service which is necessary to every person from staff.
- yes. They providing us to kits but this kit defaulted at many times and many times these kits not completed.
- yes. I found the kit from administration of quarantine Centre but some of tools which are use at any time in quarantine Centre are unavailable like sanitizer or face mask for staff.



MEDICAL STAFF AFFECTED BY COVID-19

MEDICAL STAFF AFFECTED BY EXPO CENTER ENVIRONMENT

- yes, due to the lack of facilities. Building was not well designed and no division of dirty and clean space beds of patient are open not have proper enclosure for beds of patient.
- yes, one of the staff members got infected and he recovered soon. But he infected with the poor design of Expo Centre for this kind of pandemic problems.
- some of the staff members got infected. Due to ignorance and unimplemented of precautions and safety instruction in quarantine Centre.

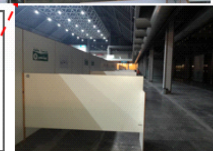
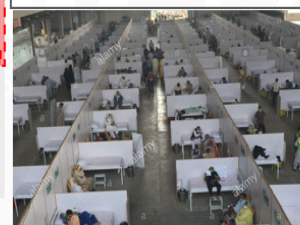


Figure 6: Staffs' response to the interview questions and their relationship with the built environment

PKLI Patients' Interview Analysis

In the patients' responses from PKLI interviews the top answered the question was "Is quarantine better at home or hospital". Most patients answered this question that obviously home is better because they feel totally free and have no boundaries, and the biggest benefit is that they are free to engage with family which makes the patient stronger to fight the disease. The second question which is more focused in this analysis is that if the hospital staff is friendly with patients. Most patients responded to this question that yes, they are, and mentioned that the staff is very cooperative and takes good care of patients and related people. The next two questions are related to the feelings of a patient with respect to the quarantine center experience and ask how they

spent their time and how they felt in quarantine time period in a hospital environment. To this, patients gave a mixed response, some patients responded that because they are allowed to go out and spend time in nature, they feel good, but some others responded that they feel very bored and would have preferred to stay home.

A good thing highlighted about PKLI in this analysis is that it has very good green spaces both indoor and outdoor, which helps patients to stay connected to the natural environment. Patients also reported in the interview that there are zones where they can go and cannot go. Figure 7 shows a detailed analysis of patients' responses in relation to the built environment.

PKLI PATIENTS INTERVIEW ANALYSIS

FEELING IN PKLI

PATIENTS CAN NOT FEEL GOOD IN PKLI

- Isolation was stressful because you have to live alone in a space for 14 days with no new experience just to watch walls and in PKLI one thing is best there is window means have visual attachment to outer life from hospital.
- The patient felt depressed. Because you have to quarantine in a room where you only one person to quarantine because this is requirement of this virus so loneliness create depression to patients.
- No. because some time in a single room we feel alone because we don't have facility to talk anyone live like our family member and other so this thing may be had negative impact on patient.
- yes. Because we have our own rooms where we have completed our quarantine period with a view of outside nature.

SEPARATE SPACE IN HOSPITAL

REQUIRED SEPARATE SPACE IN EXIST MEDICAL FACILITIES

- yes, there must be separate facility which is take over this type of patient which need very kind and comfortable environment in which they take rest and get rid from a noisy environment in hospitals.
- There should be designed facility within the hospital which is provide special services to this type of patient which are deserving special protocol for covid-19.

PKLI ENVIRONMENT AFFECTS ON MENTAL HEALTH

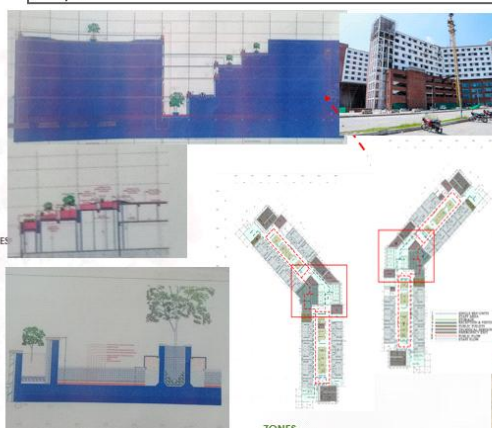
PKLI ENVIRONMENT AFFECTS THE PATIENTS MENTAL HEALTH DURING QUARANTINE

- It was quite stressful living in complete isolation without much interaction with the people and s we stay 14 alone without any conversation with any person feel bored and awful.
- yes, it is making patients stressful. Because you don't have anything to play or watch and experience in which you are engaged just only, we a thing which change over all impact of space which is design.
- yes, Patient was depressed. He wanted to go back home because they watch every time same patient's same treatment much and more patient feeling which is maximally hopeless to life that why they prefer to go there home.

PKLI ARCHITECTURAE

PATIENT FACE A DIFFERENT TYPES OF ISSUES RELATED TO SPACES AND MANAGEMENT.

- Proper Privacy provide in PKLI. Patients divide in different rooms according to patient situation.
- PKLI is design hospital which fulfill the patient requirements during pandemic.
- Proper ventilation provide for covid 19 patients which is high required for covid -19 patients.
- Circulation routes define for patients staff and visitors which create a good environment on hospital during covid 19.
- zones define in PKLI which is required of covid hospital red yellow and white zone.
- All necessary services in hospital connected with each other its also create a good environment on hospital



LANDSCAPING IN PKLI

GREEN SPACE CAN NOT CONNECTED WITH QUARANTINE CENTER

- yes, there should be green space for natural ventilation and fresh air in PKLI which have very positive impact on patient mindset and its also boost up the healing environment for patient.
- Yes, there must be some green space. For patient wellbeing which is necessary to every patient for speedy recovery.
- Yes, there should be green spaces. But these all spaces are not connected with quarantine Centre which is not proper efficient. Landscape is an element which have directly impact on patient mental physisic.



Figure 7: PKLI patients interview Analysis

PKLI Staffs' Interview Analysis

In the PKLI staff interviews analysis the question that generated the most responses was about the availability of green spaces in the hospital. To which most staff members responded that the hospital has excellent green spaces and patients love these spaces. The second and third questions that generated the most responses were also about the hospital's functionality in terms of the built environment. Staff reported that the hospital has properly designated zones for all kinds of activities. There are outer clinics for the scanning of the Covid 19 patients, and once these patients are admitted to the hospital they

are not allowed to mix with any person from the outside world, not even their family members. Questions about the hospital environment also generated very positive responses and staff responded that the environment is very clean. Staff reported in the interviews that because of the clean environment and proper zoning of the spaces, control of infectious diseases is very good. They mentioned that because it is a purpose-built hospital, it is working very well as a quarantine center. Figure 8 shows a detailed analysis of patients' responses in relation to the built environment.

PKLI STAFF INTERVIEW ANALYSIS

FEELING IN PKLI

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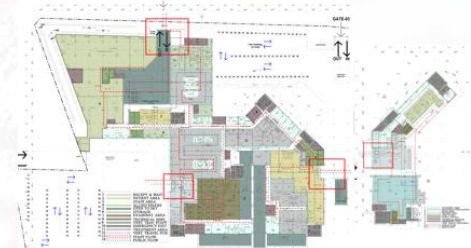
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Figure 8: PKLI Staff interview Analysis

Final Discussion

As mentioned at the beginning of the findings section, the first purpose of studying the two buildings was to examine their effectiveness in controlling infectious diseases. It is evident from the analysis that PKLI has been far more effective in controlling infectious diseases, although it wasn't a designed quarantine center, but it is a purpose-built hospital with properly designated areas, so it was easier for the management to convert it into a quarantine center and it was done through proper measurements of controlling the spaces under three zones as guided by the government policies. Expo center on the other hand did not follow these rules and the staff working there and the patients in quarantine did not even have any idea about the zones. The Expo Center's design is very effective for an exhibition space, but this makes it very inefficient for a quarantine center, authorities probably took over the building and converted it into a quarantine center because it was easily available to them and offered large spaces, but it did not have any attributes of a proper quarantine center. The biggest issues identified by the patients are a lack of privacy and a very mechanical ambiance. According to staff, the spaces were not very effective in controlling the

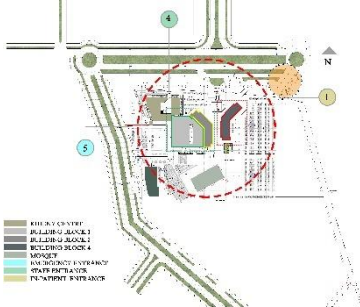
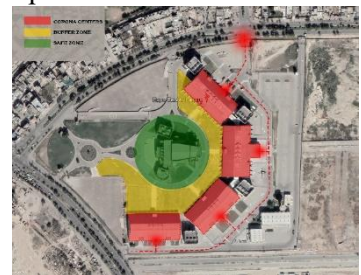
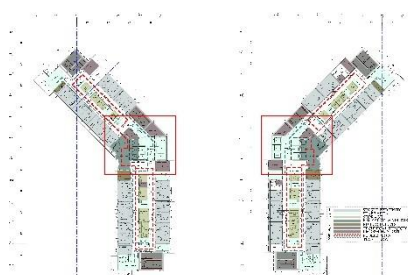
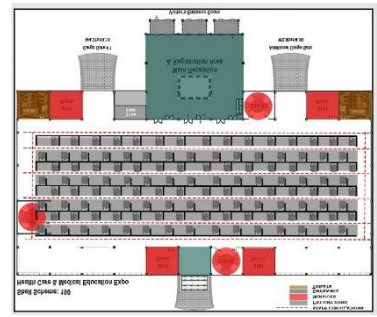
spread of infectious diseases because there was no control of movement.

The second purpose is to understand the role of these two buildings in supporting the patient's physical and mental health. Since PKLI is a purpose-built hospital, it was equipped with all the necessary requirements to provide health care to COVID-19 patients under any circumstances, and that is why it worked very well as a quarantine center. The Expo Center on the other hand had some medical facilities, but in case the patient got seriously had to be moved to a proper hospital. In terms of mental health PKLI also performed well for several reasons including the availability of private spaces to patients, and properly designed rooms with interior designs. Most importantly, the availability of green and open spaces where patients could walk once a day, they could also see these spaces through their windows enabling them to stay connected with the outside world. Expo Center on the other hand provided a very depressed environment with no privacy, no connection with the outside world, and no fresh air. All these factors affect patients' mental health. As it was discussed in

the literature review (Talevi et al., 2020), COVID-19 had a huge impact on patients' mental health and that is why providing a quarantine space that supports not only physical recovery but also provides a nourishing environment for mental health is an absolute necessity.

The third purpose of this study was to identify which of the two buildings has been more successful as a quarantine center, and it is clear from the study that PKLI has performed much better as compared to the

expo center. Table 2 provides a detailed comparative analysis of the performance of both buildings. This study makes it clear that space has a deep effect on physical and mental health. Architecture has a very strong relation to space design which is ignored initially during construction time in some hospitals because today maximum hospital uses mechanical means for ventilation but in doing so hospitals ignore how the natural environment is connected to human mental health.

Name	PKLI Hospital	Expo Center
Zoning	 <p>PKLI zoned well due to the functionality of space as three major building blocks connected with roads each separate block and very right-side chunk designated for quarantine center have separate access.</p>	 <p>Expo center zoned interlined 4 prefabricated halls which is used for expo function and they all have same entrance which make mixing and tough job for controlling he traffic.</p>
Architectural Design	 <p>PKLI is professional hospital in which space design is very well and arranged well planned according to its function in which every floor work efficiently and architecture of this building on modern line.</p>	 <p>Expo center have open hall with double heights or maximum which id open and may be infectious in case of quarantine Centre which make it poor for this purpose. Also, this kind of structure have some pros and cons but its huge structure with dead walls make it totally flop.</p>
Interior Design	PKLI have modern experience suite like single bed units which is suitable for covid-19 patient with have	Expo halls have open plan with huge structure give very bold feel but these halls never have a


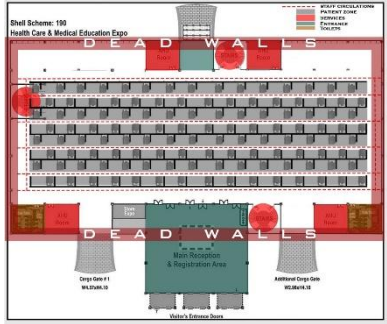
	experience of outer side as window in every room to create an experience.	puncture in walls for view which is very important to patient instead of cool ceiling the patient watch expose industrial style design of ceiling.
Biophilic Design	 <p>PKLI have green areas and all block surrounded with green patches and all of them have open to sky spaces patios in design to incorporation of biophilia for patient good health and make recovery very fast.</p>	 <p>Expo Centre have prefabricated structure which have totally different purpose to build so that why they don't have any kind of experience from outside and from sky also.</p>
Functionality	PKLI purpose base functional hospital which have more output and productivity that why people recommended for quarantine.	Design is based on totally different scenario so how we get same result like hospital from expo center.
User Comfort	PKLI have all allied services and basic need for patient which they compulsory during quarantine period.	Expo center lack in services as compare to PKLI because of expo is a temporary quarantine centre which is now removed.

Table 2: Comparative Analysis of PKLI and Expo Center

Conclusion

As mentioned earlier in the paper, Pakistan's healthcare system has always been struggling to accommodate everyone who needs it, this issue was increased on a great scale during the pandemic. It is important to invest in improving the healthcare system now and improve the quality and quantity of hospitals rather than to wait for another pandemic. This study made it clear that biophilia and green space are very important for a hospital space. Also, an added value is when the rooms are designed to incorporate these green spaces through views and by providing a provision for the patients to spend some time in the outdoor spaces. A hospital environment with the help of proper architectural design can provide much better healing both physical and psychological. Good building designs will help in fight against any future pandemic and it will help to

design future emergency health-care design facilities.

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