Remittances Review
January, 2024
Volume: 9, No: 1, pp. 2277-2304
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

Received: 10 January 2024, Accepted: 15 February 2024

DOI: https://doi.org/10.33282/rr.vx9il.97

Unveiling the potential of Epidemic-Resilient Architecture through cultural integration & responsiveness for developing countries: A Virtual Reality Exploration in Pakistan with focus on enduser participation in healthcare facilities sustainability.

1. Ar. Omer Shujat Bhatti, PhD Scholar at IIU Islamabad & Assistant Professor at UMT Lahore, omer.phdes66@iiu.edu.pk (Primary author & Corresponding author)
2. Dr. Muhammad Asad Ghufran, Associate Professor at International Islamic University Islamabad, asad.ghufran@iiu.edu.pk
3. Prof. Dr. Atta Ullah Shah, Professor & Tenured VC at Karakoram International University Gilgit-Baltistan, drshah965@gmail.com
4. Muzaffar Aziz Iqbal, Environmentalist & Civil Engineer, Islamabad. muzaffarai@gmail.com

ABSTRACT

COVID19 pandemic acted as the icebreaker by jolting the healthcare infrastructure of Pakistan towards its capacity to cope with transformation challenges for healthcare facilities, raising concerns for future epidemics as well as highlighting how cultural influences can hinder or facilitate transformation challenges. Hence there existed a need to explore how transformative healthcare architectural design with integration of cultural values may contribute to the future challenges. Based on the previous exploration from medical teams in COVID19 centers, Virtual Reality (VR) based design interventions were modeled and later evaluated using endusers participation from diversified cultural perspectives for better design evolution to meet transformation endeavors during future epidemics while keeping the existing physical infrastructure operational for allied usages in non-epidemic times. Hence it lead to adaptable, resilient and sustainable healthcare design interventions. Using VR models,

VR headsets and animations, endusers feedback was gathered and proposed design interventions were developed for two explored sites. Results showed positive responses as well as future directions based on integrating cultural prospects into the design of healthcare facilities and transformation strategies to meet the future epidemic challenges in Pakistan.

KEYWORDS : Epidemic management, Hospital transformation, Cultural challenges, Virtual Reality, Healthcare design.

INTRODUCTION

Pakistan is one of the developing countries from South Asia which faced COVID19 pandemic right from the front and its healthcare infrastructure and services got badly jolted by the worsening situation due to multiple waves of SARS COV-2 virus spread (Sohil, Sohail, & Shabbir, 2021). It was a challenging situation which lead to transformation of multiple healthcare facilities into COVID19 pandemic centers and act as a specialized facility for the targeted purpose (Rizwan, Naveed, & Salman, 2023). Since Pakistan is 5th most vulnerable nation to the climate change and has been exposed to multiple epidemics over the last more than two decades, it was anticipated that such transformation would be manageable based on the recent episodes of dengue and malaria across the country (Roy, Islam, & Singh, 2023). However it was a major obstacle faced so far in the history of healthcare in national level context with no matching precedent and magnanimity scale (Abbasi, Arshad, Nadir, & Khan, 2020). Hence this transformation took a strong tool on the people and the end users of the facilities. One of the major aspects observed was the lack of cultural integration in the whole process (Rabbani, Khan, Piryani, Khan, & Abid, 2020). Since such transformations did happened previously at a comparatively smaller scale during the last few epidemics, however such large scale healthcare intervention and its lack of sensitivity to the local cultural values due to the critical nature and higher risks of fatality and infection spread, people faced major

January, 2024
Volume: 9, No: 1, pp. 2277-2304
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

challenges to cope with it (Zakar, Yousaf, Zakar, & Fischer, 2021). Since such epidemics are anticipated to be extensively happening in future as per the World Health Organization (WHO) prediction (Laporta et al., 2023), it was deemed necessary that people serving in these spaces and healthcare facilities be taken on board with respect to future transformation challenges in time to ensure how these can be managed and be able to cope with integration of cultural dimensions as well as critical environmental, functional, healthcare, operational and engineering design aspects. One of the most modern and state of the art facility developed as proactive approach to the design of such facilities is Virtual Reality (VR) (Kolbe, Jaywant, Gupta, Vanderlind, & Jabbour, 2021). It was proposed that based on the earlier exploration about the users issues and cultural dimensions explored, VR could be used to prepare models which can be viewed by the stake holders and give feedback towards better integration of operational and allied aspects so that during epidemics these issues could be easily managed. Hence two major research objectives were set forth:

1. To model a VR model of the proposed epidemic unit to take care for the patients in both epidemic and non-epidemic conditions to be sustainable.
2. To evaluate the end users feedback towards cultural and allied dimensions for the satisfaction towards both timeline uses.

Based on the defined lines, research exploration was taken forward through exploration of the review of literature to define research methodology followed and later execution of the research itself. This research has a very significant role to play in the future of the epidemic centers and their cultural dimensions where the social aspects were previously ignored but now have been proposed to be integrated. It defines the current issues in the modern day timeline with focus on the epidemic transformation challenges in healthcare facilities and

allied social as well as cultural aspects integration to enable better end user satisfaction at an early stage to deliver design efficiency and success.

REVIEW OF LITERATURE

Epidemics have been a large scale challenge since the mankind history has been recorded and have contributed to large scale destruction of mankind across the globe. Pandemics, on the other hand, have large devastating impacts yet their frequency was very low but with even higher scale of spread and destruction (Jarvis, William, Jarvis, & Orford, 2007). With recent COVID19 pandemic, global health crisis took the world like a bush fire and no place was any safe any point. It was evident that this spread of virus will repeat previous pandemic history and will be a major threat to survivability of human life (Bedford et al., 2019). Pandemic shattered the healthcare system from its core and even developed countries like Italy faced major crisis. Pakistan, one of the developing country of the third world, faced the challenge like no other and it took a strong tool on its healthcare system (Hammoumi & Qesmi, 2020). With its deep roots in ideologies, cultural backgrounds and norms & traditions practiced across the country, the isolation, quarantine and allied measures of smart lockdown raised serious concerns for the people across the nation (Shakil, Ashraf, Muazzam, Amjad, & Javed, 2022).

With a different cultural aspects associated with illness of a patient followed by whole family accompanying him or her to the hospital and if the same has to take the patient to another city, they will accompany them (Shahil Feroz, Ali, Feroz, Akber, & Nazim Meghani, 2021). It is also prevalent that with one patient, there will be many people visiting and taking their pride to help the needy family with staying back at the hospital in their place during day and night hours. People during COVID19 when told to leave their near ones and will not be allowed to visit or meet them and incase if they die their dead bodies will not be handed over

January, 2024
Volume: 9, No: 1, pp. 2277-2304
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

to them, caused a major issue and turmoil amongst the masses (Rabbani et al., 2020). It was something which public were very hesitant to accept or even acknowledge.

In later stages, actions of smart lock downs, closing of mosques and educational institutions as well as congregations and other social events, it was strongly opposed by the people but was forcefully promulgated (Zakar et al., 2021). It has been observed that this lack of integration of cultural aspects through exploration in a critical time where social dimensions could have been overlaid with other critical aspects like infection control, segregation, buffer zoning and allied healthcare and operational protocols could have served a much better response and effective results (Abbasi et al., 2020). Lack of such integration triggered many issues including stress, anxiety and lack of focus & commitment to the work place settings and delivery of services itself by the healthcare providers while people trying to avail their services at that point were in an unprecedented medical conditions which could lead to death or long term illness (Paskarini, Dwiyanti, Syaiful, & Syanindita, 2023).

It was also evident that since these facilities were initially not designed in a fashion to cope with such issues and conditions, their design transformation itself raised many question and concerns towards their successful transformation to serve as a COVID19 pandemic center or facilitation unit (Ministry of Health and Family Welfare, 2020). With such transformation, the health risk as well as mental, physical, psychological and social pressure did their part to torment the people serving in these spaces and later faced challenges related to cultural and social acceptance amongst their most immediate neighborhood either at homes or in work places (Sarfraz, Hafeez, Abdullah, Ivascu, & Ozturk, 2022). This phenomena further segregated the society through lack of cultural aspects integration into the design of such facilities. It is clear at this stage that such a transformation was not easy to opt for any of the stakeholders i.e. Government, healthcare facility administrators, managers, medical teams,

support staff and allied as well as the people who have been suffering from the SARS COV-2 virus and were in immediate need of medical attention, a proactive planning could have resulted in better cohesion and acceptance of these challenges by the people on either side and enable better results. Hence in future, a proactive approach with prior stakeholders integration and visualization of the proposed design transformation related to future epidemics could give better results and higher acceptance if integrated with cultural, social, environmental and allied technical as well as medical aspects. It was explored that hospitals with potential to transform into epidemic units must be identified and further explore with respect to implementation of a design solution where these could be evaluated prior to be build and later using prefabricated modern day technologies could be built on immediate basis (Bhatti & Ghufran, 2020). While during an epidemic they will be used extensively for the epidemic management purposes but during the non-epidemic time would be used for allied healthcare operational works and facilitation like Out-Patient Departments, medical clinics, etc (Bhatti, Ghufran, & Shah, 2023).

RESEARCH METHODOLOGY

The overall research methodology followed is shown below in figure 1.

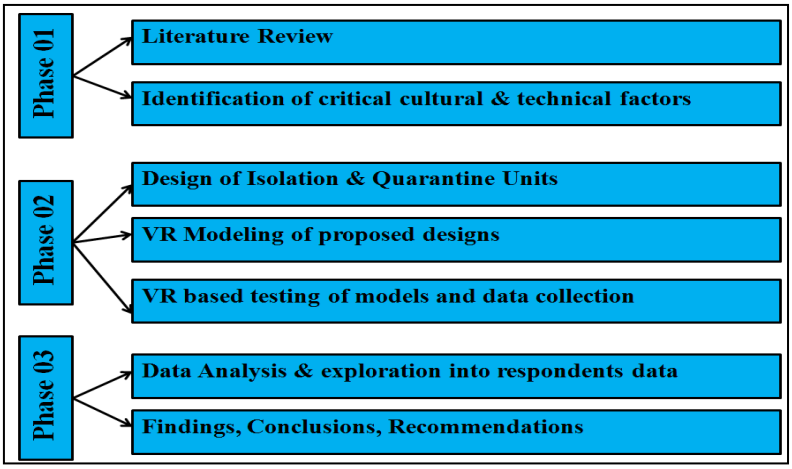


Figure 01 Research phases and major steps

January, 2024
Volume: 9, No: 1, pp. 2277-2304
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

In order to carry forward the research, a two way approach was used. Based on the identified aspects from previous respondents designing of the facility was done and its VR model was developed. Later it was shared through online platform to be easily accessed through VR headset and smart phones for better evaluation and understanding. Then a questionnaire based tool was used to evaluate the data provided by the respondents who have explored the design and its parameters based on the current set forth criteria. Online questionnaire was circulated to more than 75 respondents targeted to have served in the previously selected COVID19 center (Riphah International Hospital – RIH) while 57 respondents provided feedback with 76% success rate. The details of the research execution, proposed design, design evolution and data collection are shared below.

DATA COLLECTION & ANALYSIS

One of the COVID19 pandemic center i.e. RIH was selected and its existing site and design were documented as shown below. Later based on the review of literature and the proposed design interventions in the form of pre-fabricated design were deployed through developing design solutions to address the epidemic management integrating cultural aspects of the local context and public priority through architectural and environmental design.

Figure 02 Location of RIH in Sihala, Islamabad (Google Earth Map, 2022)

Figure 03 RIH access from main Islamabad expressway (Google Earth, 2022)

Figure 04 Master plan of the RIH site

The RIH site is located near Sihala, on the outskirts of Islamabad's central city, and is easily reachable from the primary Islamabad highway at a distance of 2000 feet from the main road as shown above in figure 02-04. The master plan of the facility is shown below in figure 05.

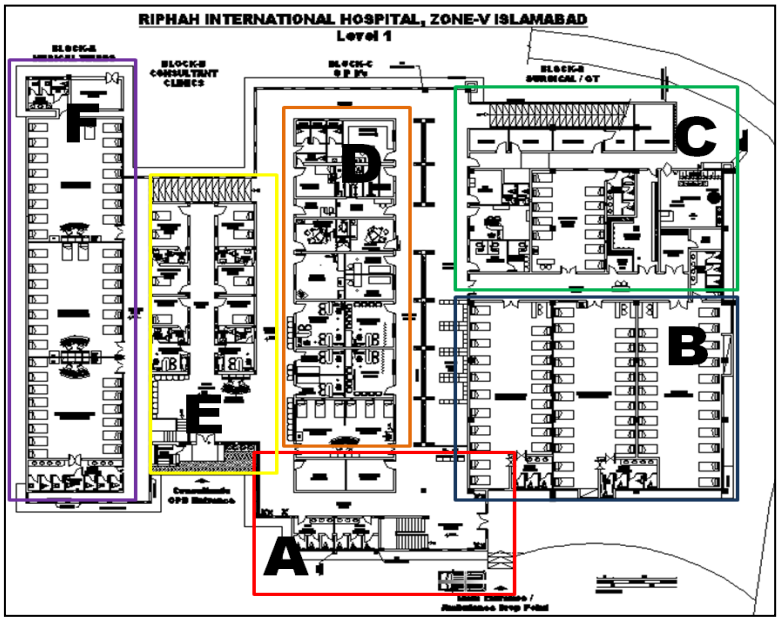


Figure 05 Overall Ground Floor Plan of the RIH

As evident from figure 04, The RIH site's master plan illustrates that the entire complex is made up of several interconnected blocks with varying elevations that may be seen on a Google Earth map. The primary access road leading to the facility passes via a number of teaching rooms, an allied nursing dormitory, and a pharmacy and café housed in a single structure with open parking and access to the main building on the north side. There is parking available on the main building's north, south, and west sides. The main building façade and its context is shown below in figure 06.

Figure 06 Exterior façade of the main building

January, 2024
Volume: 9, No: 1, pp. 2277-2304
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

The figure 05 shows the overall composition of multiple departments and functions with Bloack serving as main entrance and Accident & Emergency department, Block B serves for Gynecology & Pediatric wards, Block C serves multiple admin and allied functions, Block D serves Out Patient Departmental (OPD) clinics, Block E serves for private rooms along with specialized clinics and Block F Serves for Male wards both surgical and medical. Block E & F were transformed into COVID19 unit. The transformation done during COVID19 pandemic time is shown below in figure 07.

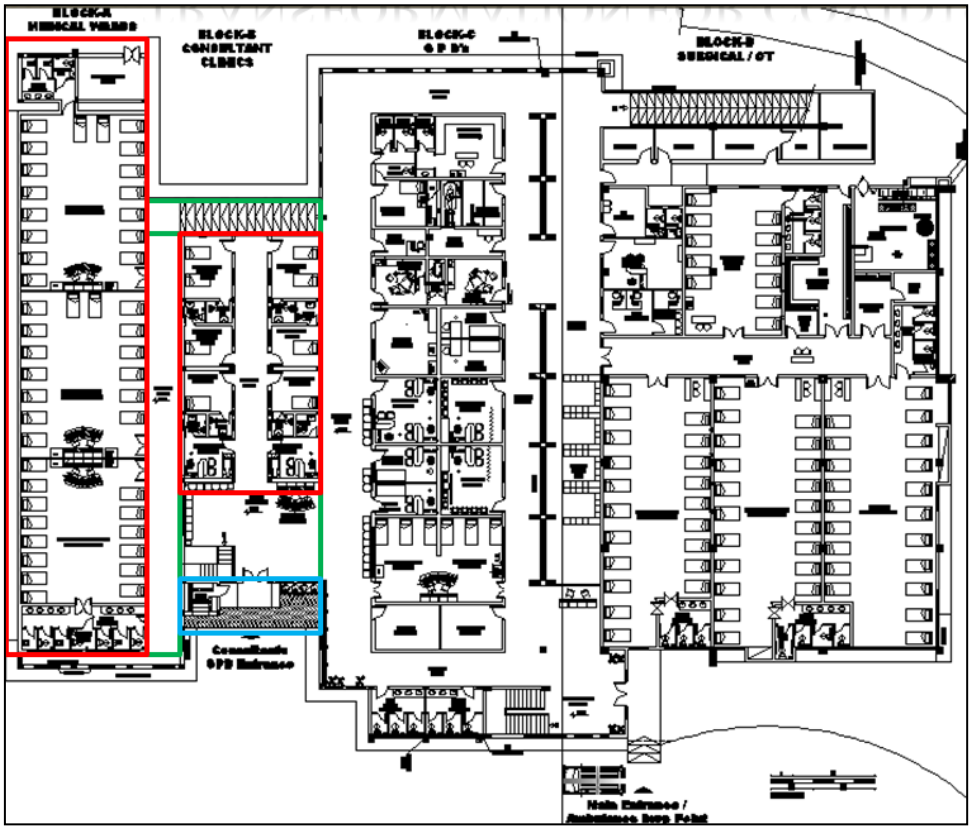


Figure 07 RIH – Bifurcation & Segregation plan for COVID19 pandemic

As shown above in figure 07, Red block marks the major COVID19 patient spaces, Green marks the passage & access link and Blue marks the services & allied. As evident, two of the blocks on the western side were set aside specifically for the purpose, complete with all of their spaces and functional rooms, in order to handle the increased impulsive inflow of

January, 2024
Volume: 9, No: 1, pp. 2277-2304
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

COVID-19 patients and transform the RIH into a COVID19 center. In order to proceed ahead with epidemic based future intervention to integrate the cultural aspects as well as managing epidemics, the location of the site and its division is shown below.

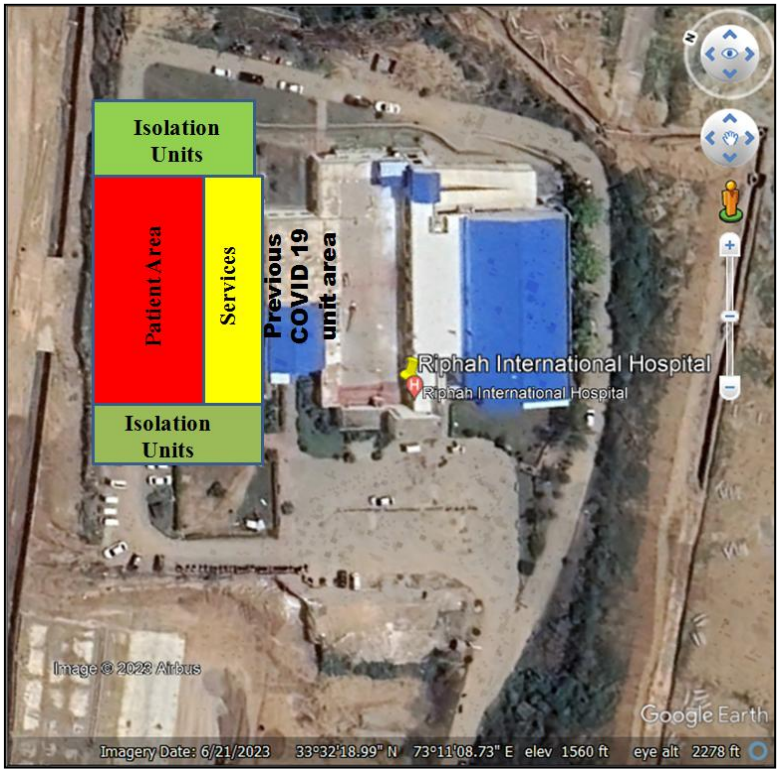


Figure 08 Proposed expansion area for epidemic transformation at RIH

As evident above in the figure 08, the location adjacent to the decommissioned COVID-19 facility was the most suitable for the future epidemic expansion plan, as it allowed for flexible use of prefabricated design solutions integrated with the existing built form and physical infrastructure. The design changed throughout time as a result of baselining the specifications that were previously presented through exploration of primary data from RIH medical teams and helped to implement measures that would guarantee epidemic management, execution, and readiness in future through cultural aspects integration with design. The proposed design for epidemic intervention is shown below in figure 09.

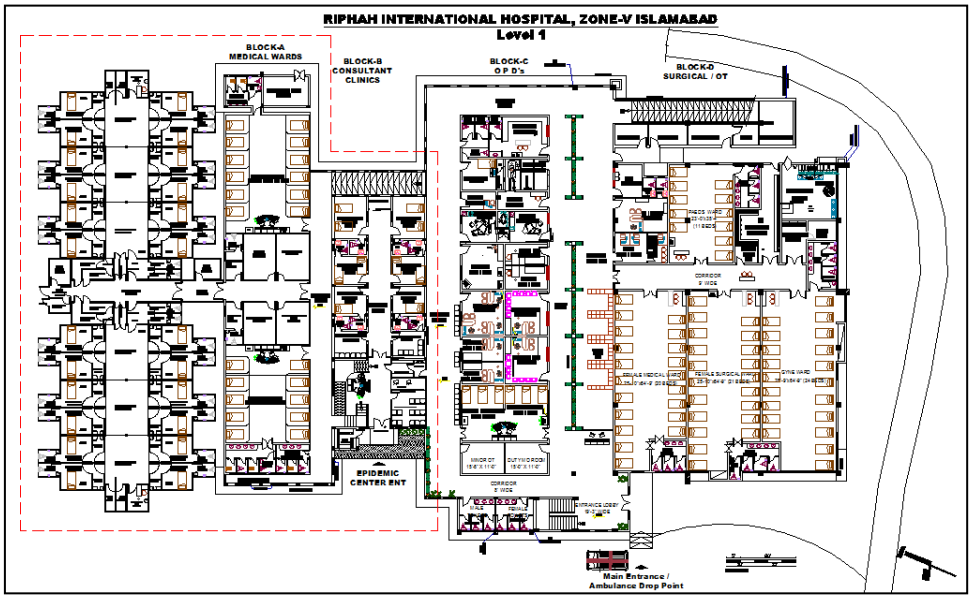


Figure 09 Proposed Epidemic based Intervention – Master Plan

As evident from the proposed master plan interventions for epidemic management shown in figure 09, multiple prefabricated units were incorporated in design to provide typical design solution for isolation and quarantine while enabling better communication, spaces for view and enabling local relatives/near ones to be close to the patients. The detailed design of the basic unit is shown below.

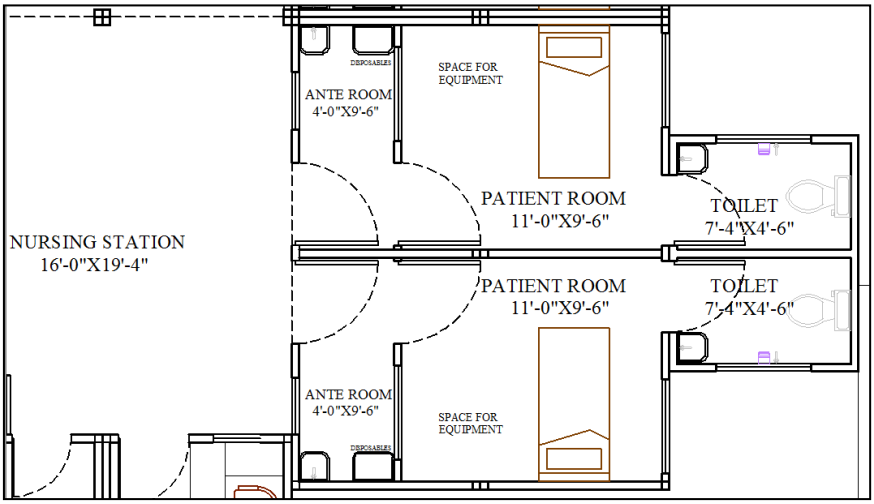


Figure 10 Single Isolation Unit blowup

January, 2024
Volume: 9, No: 1, pp. 2277-2304
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

As shown above in the figure 10, typical prefabricated Isolation unit using standard steel containers have been proposed. Each unit would consist of one buffer room with windows and allied washing area as well as storage with a total area of 4 feet by 9.5 feet leading to main isolation room with negative pressure to manage air movement with an ample size of 11 feet by 9.5 feet and further lead into attached toilet of 7 feet & 4 inches by 4 feet & 6 inches. Later in order to enable its sustainable usage in the non-epidemic days, the configuration was modified as shown below.

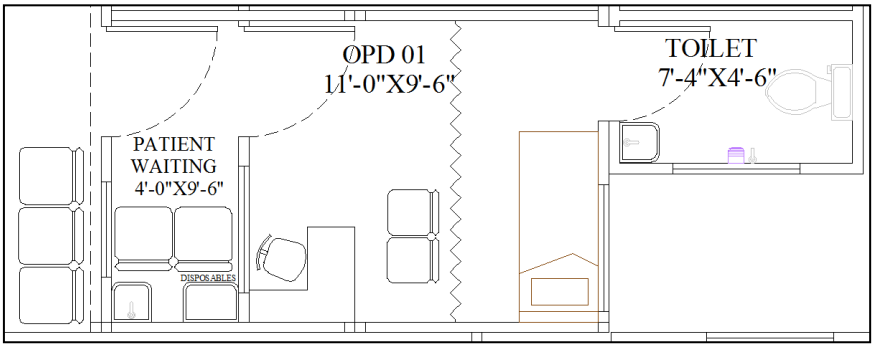


Figure 11 Internal OPD layout after primary data integration

Ash shown above in figure 11, internal planning for the OPD was devised. This enables addition of a couch to the OPD space which will be beneficial for clinics associated with Orthopedics, Gynecology, Pediatric, Geriatric and many other allied OPD clinics with addition of privacy and where patients have to be observed or evaluated while they are placed on the couch. Similar can also be used as a separate Ultrasound facility for patients. The added chairs will facilitate the attendants incase of patient waiting. The above two designs were later to be evaluated through VR modeling. The proposed Isolation unit design was used as a model to develop its renderings and then were later transformed into VR video which was able to help evaluate the interior spaces and overall appearance. The Isolation 3D model is shown below:

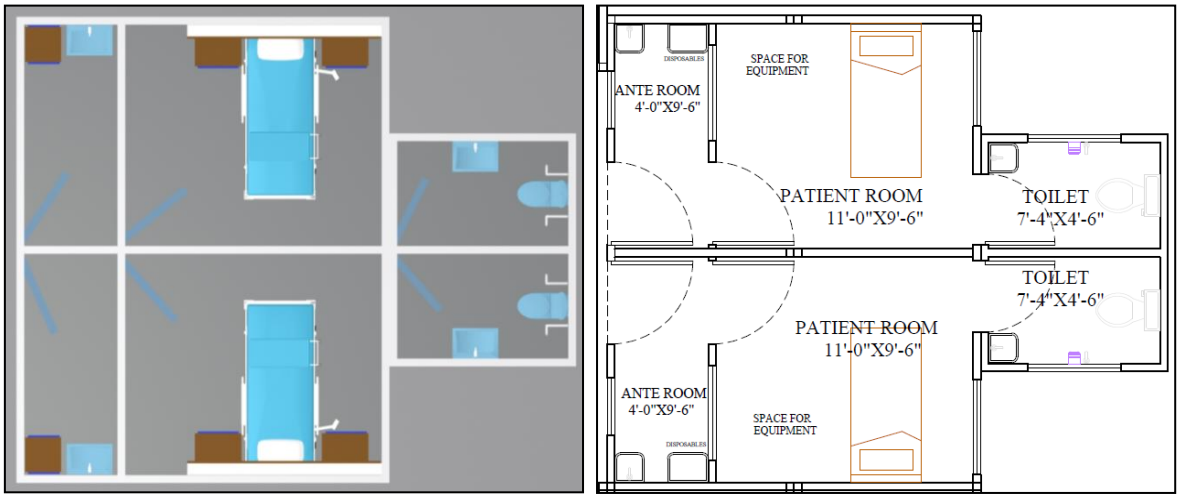


Figure 12 Proposed Isolation Unit & its 3D Model

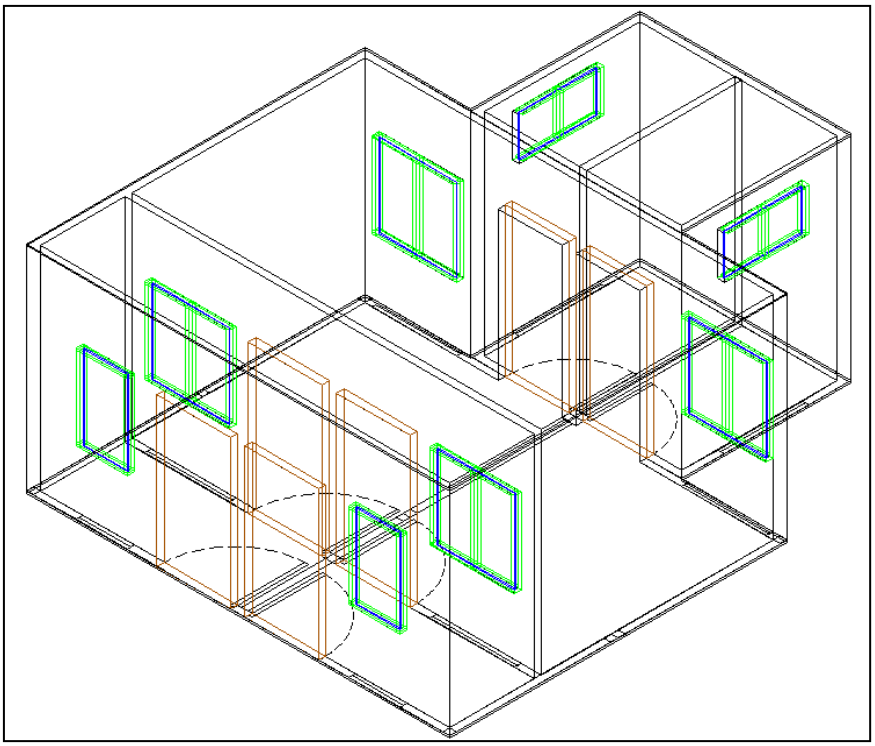


Figure 13 AutoCAD generated 3D virtual model of the isolation unit

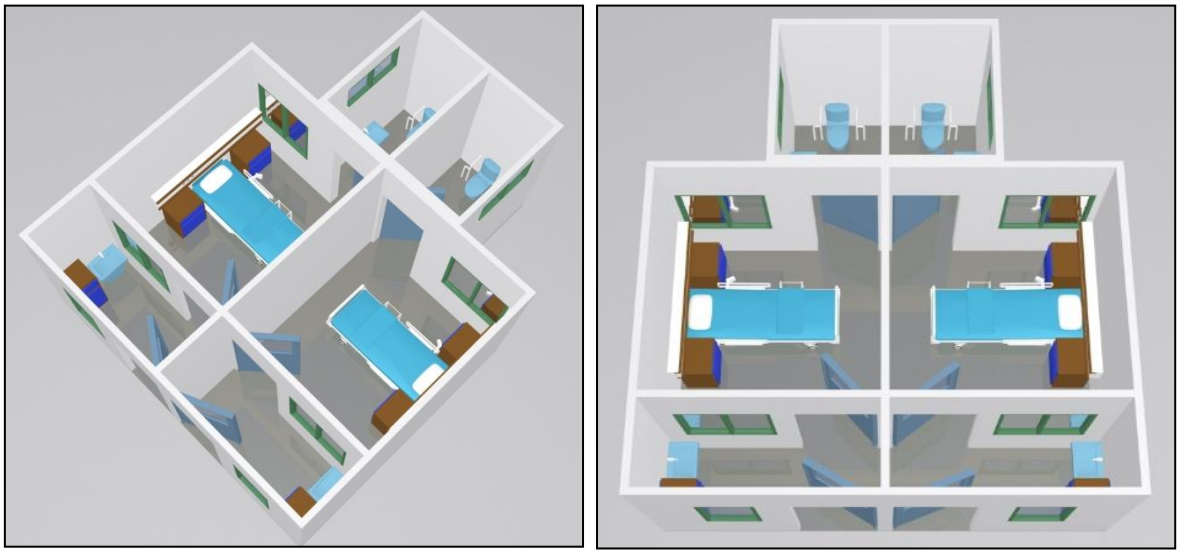


Figure 14 Renderings of the Proposed Isolation 3D Model using 3DS Max

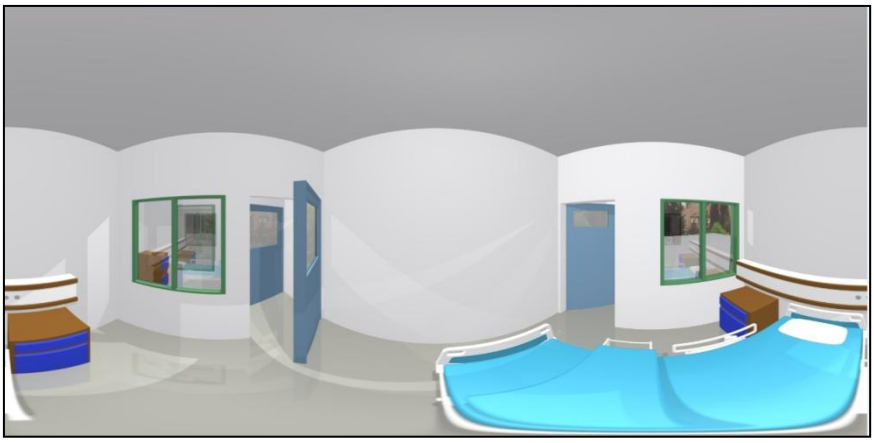
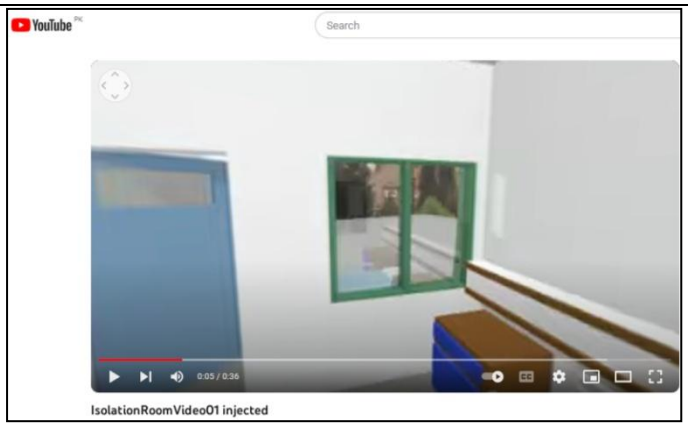
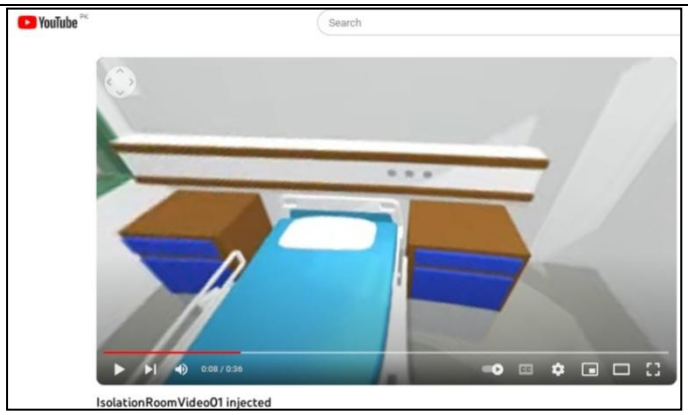


Figure 15 Panoramic view of the 3D Isolation Unit using 3DS Max

As shown above in the figure 12 to 15, proposed design for the isolation unit was virtually modeled using AutoCAD as the main software for planning and drafting while later the same model was imported into 3DS Max software for the purpose of environment, lighting, materialization and renderings creation. Once these have been completed, Panaromic view settings were used to export the Figure 15 and later it was transformed into a video using online editing tools along with addition of meta data. The developed animation / video was later published on www.Youtube.com for easy access and viewing capability for the reviewers. The video had the capability to be used for virtual viewing in 3D using cell phone as well any other desktop/laptop. The images from the video on youtube are shown below.

Remittances Review
January, 2024
Volume: 9, No: 1, pp. 2277-2304
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

Table 01 Isolation Room 3D VR video images

S.No	Figure Detail	Figure
01	Main view of exterior window and bed along with toilet door	
02	Bed layout with allied spaces for equipment	
03	Main Isolation room entrance door and buffer zone	

As shown above in the table 01, the images clearly show that video had meta data enabled and was rotatable even using cell phone or desktop/laptop device. For better viewing experience, cell phone with gyroscopes were proposed to the viewers but existing design

January, 2024
Volume: 9, No: 1, pp. 2277-2304
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

enabled user friendly approach to enable any Android cell phone to be used for the review purpose. Later same process was repeated for the OPD clinic design within the Isolation unit to enable its adaptation in the non-epidemic times to ensure optimization in functional usage of the built environment. The proposed design and its model is shown below.

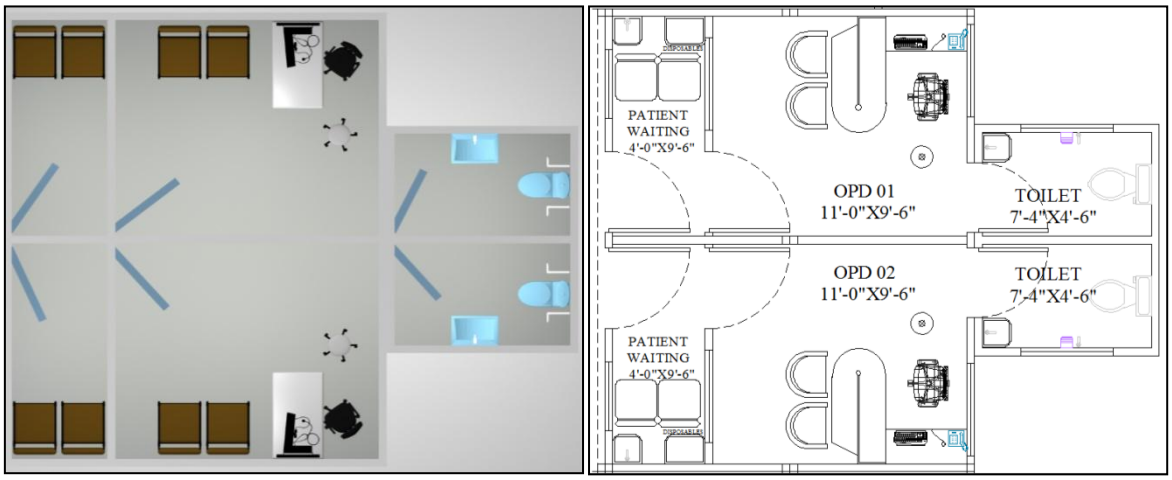


Figure 16 Proposed design of OPD clinic in the Isolation unit

Figure 17 Rendering of the proposed OPD Clinic

January, 2024
Volume: 9, No: 1, pp. 2277-2304
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

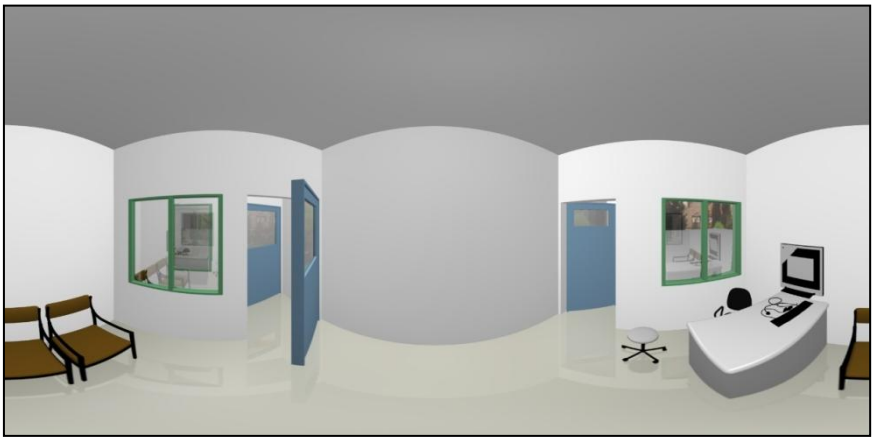


Figure 18 Panoramic VR view of the OPD clinic design

As shared previously in the Isolation Unit modeling and VR development, same process was also followed for the OPD clinic design. Figure 16 shows the proposed plan along with its top view and figure 17 shows the perspective rendering of the 3D model developed & figure 18 shows panoramic render of the interior OPD clinic design. The detailed VR video based images from the www.youtube.com channel uploaded by the researcher are shown below in table 02.

Table 02 OPD clinic 3D VR video images

S.No	Figure Detail	Figure
01	Main view of exterior window and clinician table and patient seat	

02	Clinician table and attendant seats	
03	Main Isolation room entrance door and buffer zone	

As shown above in the table 02, multiple images from the VR model based video from youtube have been extracted. Later the video links were shared with respondents and data was collected from them using online questionnaires.

The data collected based on the comparison of both the functions and user satisfaction with the planned / proposed isolation as well as OPD clinic design are shared below. The online questionnaire along with video links and VR video links were shared to future prospective end users of RIH. It consisted of 75 however only 57 responded the questionnaire with a response rate of 76%. The details of the respondents basic demographics is shared below in Table 03.

Table 03 Respondents Demographics

S.No	Aspect	Type	Count	%	Type	Count	%
1	**Gender**	Male	20	35%	Female	37	65%
2	**Age Groups**	Below 25	3	5%	26-35	21	37%
		36-45	28	49%	46-60	5	9%
		Above 60	0	0%			
3	**Profession**	Doctor	9	16%	Nurse	23	40%
		Paramedic	9	16%	Medical Staff	6	11%
		Allied	1	2%	Admin	9	16%
4	**Have you served in an Isolation / Pandemic / Epidemic Unit?**	YES	55	96%	NO	2	4%

As shown above in the table 03, major contributors amongst the identified categories have been highlighted in grey color. Female respondents counted for 37 out of 57 (65%), Major age group was 36-45 with 49% respondents falling into it, Nurses shared the major professional chunk with 40% representation and 96% of the respondents have already served in an isolation/epidemic/pandemic unit. Hence it was evident that 96% of the respondents do understand the technical, physical, medical psychological, mental, functional and allied aspects associated with epidemic patients management and will be able to correspond to relating Isolation Unit design with OPD unit design. The respondents data related to Isolation unit design user satisfaction is shared below:

Table 04 Respondents data Isolation Unit design user satisfaction

Comparative User Satisfaction with Isolation Unit & OPD Facility Design											
	Major aspects / Functions - Isolation Unit Design	**Unsatisfied**	**%**	**Unsatisfied**	**%**	**Unclear**	**%**	**Satisfied**	**%**	**Satisfied**	**%**
6	Ease of accessibility & communication	2	4 %	4	7%	10	18 %	34	60 %	7	12 %
7	Ease of Segregation	0	0 %	4	7%	12	21 %	36	63 %	5	9%
8	Manageable incase of epidemic severity	3	5 %	7	12 %	21	37 %	23	40 %	3	5%
9	Infection prevention & Control	7	12 %	6	11 %	3	5%	34	60 %	7	12 %
10	Managing human resources & Logistics	1	2 %	4	7%	15	26 %	31	54 %	6	11 %
11	Internal Pharmacy	3	5 %	24	42 %	8	14 %	15	26 %	7	12 %
12	Internal Lab/Phlebotomy/Diagnostics	1	2 %	3	5%	12	21 %	31	54 %	10	18 %
13	Essential support services	3	5 %	7	12 %	21	37 %	23	40 %	3	5%
14	Essential healthcare services	1	2 %	4	7%	15	26 %	31	54 %	6	11 %
15	Psychological and Social Support	12	21	11	19	31	54	3	5	0	0%

	Services		%		%		%		%		
16	Patient Management	0	0 %	4	7%	12	21 %	36	63 %	5	9%
17	Surge capacity	7	12 %	4	7%	5	9%	37	65 %	4	7%
18	Transformation	1	2 %	4	7%	15	26 %	33	58 %	4	7%
19	Future directions to consider:										

As shown above in the table 04, major aspects associated with design of Isolation unit through review of literature were explored from the respondents and their results clearly show in grey areas that the major issues yet to be addressed include towards improved user satisfaction included Internal Pharmacy due to its distant location and lack of spaces for Psychological and Social support. Rest in all major aspects, majority of the respondents agreed that in managing the severe epidemic times, proposed design solution will act as an asset towards immediate deployment and construction. However in future directions to consider, majority did proposed to opt for a small prototype to test first as this proposed model is not physically built and only evaluated virtually on through design proposed in drawings. The respondents data for OPD unit design using the same physical design of isolation unit through transformation of functions and optimization is shown below in table 05.

Table 05 Respondents data OPD Unit design user satisfaction

Comparative User Satisfaction with Isolation Unit & OPD Facility Design											
	Major aspects / Functions - Isolation Unit Design	**Unsatisfied**	**%**	**Unsatisfied**	**%**	**Unclear**	**%**	**Satisfied**	**%**	**Satisfied**	**%**
20	Ease of accessibility & communication	2	4%	8	14 %	5	9%	35	61 %	7	12 %
21	Basic utilities - Storage, Clean utility, dirty utility, staff room, nursing stations, etc	4	7%	5	9%	4	7%	31	54 %	13	23 %
22	Ample sitting & waiting	1	2%	4	7%	6	11 %	41	72 %	5	9%
23	Ample number of clinics	0	0%	9	16 %	9	16 %	38	67 %	1	2%
24	Internal diagnostics	3	5%	24	42 %	8	14 %	15	26 %	7	12 %
25	Record room	8	14 %	13	23 %	21	37 %	12	21 %	4	7%
26	Pharmacy	0	0%	4	7%	12	21 %	36	63 %	5	9%
27	Registration & allied	4	7%	5	9%	4	7%	31	54 %	13	23 %
28	Future directions to consider:										

As evident from the data shown above in the table 05, two major areas with poor or lack of satisfaction towards OPD unit design included internal diagnostics due to distant

January, 2024
Volume: 9, No: 1, pp. 2277-2304
ISSN: 2059-6588(Print) | ISSN 2059-6596(Online)

location and missing of proper OPD dedicated record rooms. Piloting the same was again proposed in the OPD unit design evaluation too.

Overall respondents did agreed that the proposed design solutions and interventions could be used in future to manage the disease burden during any epidemic situation which may pose challenges to existing fragile healthcare infrastructure of the country through adding a pre-fabricated design solution which will be cost effective and time efficient to manage the healthcare challenge.

It is critical to mention here that evolved design explored the cultural aspects of the local people with focus on how these could be managed without compromising the healthcare technical needs associated with infection control, bifurcation, zoning, isolation, etc. Privacy was introduced which was missing primarily in all previous design interventions. Separate view bays and windows were introduced next to the patients in their isolation, quarantine or typical single unit rooms to ensure they have a close contact with family members through viewing them. Since these rooms were internally intact and no openings were allowed to be managed by the patients except for internal medical/admin teams, thus the risk of infection spread was also reduced. Without respect and integration of cultural dimensions, the gaps prevailed in the pandemic time would have been repeated and would not have been integrated in the proposed design for epidemics management. Being generic in principle and expandable, these could be used in similar contexts with minor adjustments based on the local climatic conditions as well as cultural and social consideration without compromising any health related operational protocol or standard.

RESEARCH FINDINGS & CONCLUSIONS

As evident from the research exploration, cultural values depict the people opinion and help transform their critique into positive acceptance through integration of their opinion and cultural values. It is pertinent to mention that though the data explored was limited to one COVID19 center representatives, yet it should be explored at a larger audience with same prospects. Proactive approach would yield better results as now the design integration and development of a proposed emergency plan has been baselined with respect to one selected healthcare facility. Both objectives of the research were completed and successful VR based models were used to explore the anticipated end users opinion for future design interventions through prefabricated design solutions which were cost, energy and time efficient to manage the burden of future epidemics in Pakistan to reduce their negative impacts while keeping inline with healthcare standards and protocols. Since these unprecedented challenges may rise at any time and transform into large scale risks, similar research should be done in other allied healthcare facilities which have the provision and capability to be transformed into epidemic centers and manage epidemics in future.

REFERENCES:

Abbasi, M. A., Arshad, M., Nadir, R., & Khan, M. (2020). Spread of covid-19 and its impact on pakistan: a need for prospective planning, *2020*(I), 16–30.

Bedford, J., Farrar, J., Ihekweazu, C., Kang, G., Koopmans, M., & Nkengasong, J. (2019). A new twenty-first century science for effective epidemic response. *Nature*, *575*(7781), 130–136. https://doi.org/10.1038/s41586-019-1717-y

Bhatti, O. S., & Ghufran, A. (2020). YOUNG SCHOLARS CONTRIBUTIONS PAKISTAN

HEALTHCARE INFRASTRUCTURE AND COVID-19 : A CASE FOR ISOLATION AND QUARANTINE FACILITIES OPTIMIZATION IN THE CONTEXT OF PAKISTAN Omer Shujat Bhatti *. *Journal of Research in Architecture and Planning*, *29*, 36–45.

Bhatti, O. S., Ghufran, M. A., & Shah, A. (2023). Transforming Adversity into Opportunity: Assessing User Satisfaction in Hospital Transformation in Lieu of a Pandemic through the Multi-Corridor Expansion Model for epidemic Management and Environmental Design Enhancement. *Nakhara: Journal of Environmental Design and Planning*, *22(2)*.

Hammoumi, A., & Qesmi, R. (2020). Impact assessment of containment measure against COVID-19 spread in Morocco. *Chaos, Solitons and Fractals*, *140*, 110231. https://doi.org/10.1016/j.chaos.2020.110231

Jarvis, E., William, R., Jarvis, W. R., & Orford, P. (2007). *Bennett & Brachman's Hospital Infections*.

Kolbe, L., Jaywant, A., Gupta, A., Vanderlind, W. M., & Jabbour, G. (2021). Use of virtual reality in the inpatient rehabilitation of COVID-19 patients. *General Hospital Psychiatry*, *71*(January), 76–81. https://doi.org/10.1016/j.genhosppsych.2021.04.008

Laporta, G. Z., Potter, A. M., Oliveira, J. F. A., Bourke, B. P., Pecor, D. B., & Linton, Y. M. (2023). Global Distribution of Aedes aegypti and Aedes albopictus in a Climate Change Scenario of Regional Rivalry. *Insects*, *14*(1). https://doi.org/10.3390/insects14010049

Ministry of Health and Family Welfare. (2020). Clinical Management Guidelines for Covid19. *CDC Guidelines*, (July). Retrieved from https://stopcorona.tn.gov.in/wp-content/uploads/2020/03/TNSOP-6-1-version-1.3.pdf

Paskarini, I., Dwiyanti, E., Syaiful, D. A., & Syanindita, D. (2023). Burnout among nurses: Examining psychosocial work environment causes. *Journal of Public Health Research*, *12*(1). https://doi.org/10.1177/22799036221147812

Rabbani, F., Khan, H. A., Piryani, S., Khan, A. R., & Abid, F. (2020). Psychological and social impact of COVID-19 in Pakistan: Need for Gender Responsive Policies. *MedRxiv*, (9221), 2020.10.28.20221069. Retrieved from https://doi.org/10.1101/2020.10.28.20221069

Rizwan, A., Naveed, S., & Salman, Y. (2023). An analysis of policies, challenges and outcomes in Pakistan through co-creation of COVID-19 responses. *Public Administration and Policy*, *26*(1), 107–119. https://doi.org/10.1108/PAP-05-2022-0041

Roy, M. G., Islam, M. M., & Singh, A. (2023). Prevalence of dengue virus, their infection, diagnosis, and challenges. *Journal of Applied Biology and Biotechnology*, *11*(3), 20–27. https://doi.org/10.7324/JABB.2023.74648

Sarfraz, M., Hafeez, H., Abdullah, M. I., Ivascu, L., & Ozturk, I. (2022). The effects of the COVID-19 pandemic on healthcare workers' psychological and mental health: The moderating role of felt obligation. *Work*, *71*(3), 539–550. https://doi.org/10.3233/WOR-211073

Shahil Feroz, A., Ali, N. A., Feroz, R., Akber, N., & Nazim Meghani, S. (2021). Exploring community perceptions, attitudes and practices regarding the COVID-19 pandemic in Karachi, Pakistan. *BMJ Open*, *11*(8), 1–8. https://doi.org/10.1136/bmjopen-2020-048359

Shakil, M., Ashraf, F., Muazzam, A., Amjad, M., & Javed, S. (2022). Work status, death anxiety and psychological distress during COVID-19 pandemic: Implications of the

terror management theory. *Death Studies*, *46*(5), 1100–1105. https://doi.org/10.1080/07481187.2020.1865479

Sohil, F., Sohail, M. U., & Shabbir, J. (2021). COVID-19 in Pakistan: Challenges and priorities. *Cogent Medicine*, *8*(1). https://doi.org/10.1080/2331205x.2021.1966179

Zakar, R., Yousaf, F., Zakar, M. Z., & Fischer, F. (2021). Sociocultural Challenges in the Implementation of COVID-19 Public Health Measures: Results From a Qualitative Study in Punjab, Pakistan. *Frontiers in Public Health*, *9*(July). https://doi.org/10.3389/fpubh.2021.703825