

# RETHINKING ARCHITECTURAL DESIGN AND HOSPITAL TRANSFORMATION THROUGH NEED BASED ASSESSMENT IN LIEU OF COVID19 PANDEMIC. A CASE FOR MISSING EPIDEMIC CONSIDERATIONS IN HEALTHCARE DESIGN OPTIMIZATION.

**Omer Shujat Bhatti**

*PhD Scholar, International Islamic University Islamabad*

**Dr. Muhammad Asad Ghufuran**

*Associate Professor, International Islamic University Islamabad*

**Prof. Dr. Attaullah Shah**

*Tenured VC & Professor, Karakoram International University, GB*

## ABSTRACT

**Background.** Epidemics have always been a great burden on the healthcare system and caused severe losses to people and assets in developing countries like Pakistan. Since Pakistan has been facing epidemics ever since its birth, it was assumed that the existing healthcare system and design would be able to cope with the existing epidemic and COVID 19 pandemic situation. Yet it failed and the situation worsened with almost 24,000 above deaths and above 100,000 confirmed cases in pandemic in recent past. **Objective.** The present study was conducted to (i) evaluate how the existing system failed to manage during the COVID19 pandemic (ii) what were the major causes of this failure with focus on healthcare facility design and how these could be addressed. **Method.** In order to achieve the above mentioned objectives, an online questionnaire based on the WHO guidelines for epidemic preparedness was developed and was shared to 250 targeted medical professionals working in COVID19 related facilities across the country during the 3rd & 4th COVID19 waves and 172 responded with a feedback ratio of 68%. **Findings.** Based on the data obtained, it was concluded that existing healthcare system ignored the aspects of epidemics in the design and planning of the healthcare facilities and hospitals. This led to failure in pandemic management strategies and protocols leading to worst case scenario. Transformation of these facilities faced many challenges. With 98% of the respondents considered to incorporate upgrades consideration for isolation and quarantine into the design of healthcare facilities and their future up gradation. **Recommendations.** Existing gap must also be explored with healthcare designers / architects in Pakistan to highlight the policy or design gap causing this disaster. Existing designated COVID 19 facilities must also be re-explored in the current situation.

## ARTICLE INFO

### *Keywords:*

Epidemics, Pakistan, Healthcare system, Architecture, Epidemic preparedness, design interventions.

### *Article History:*

Received: 18<sup>th</sup> Apr 2023  
Accepted: 21<sup>st</sup> May 2023  
Published: 05<sup>th</sup> Jun 2023

© 2023 The authors. Published by CADDO GAP Press USA. This is an open access article under the Creative Commons Attribution NonCommercial 4.0

## 1. INTRODUCTION

Epidemics across the globe has been one of the most strongest forces against the mankind and humanity toward survival (Dewar et al., 2014). They create threats to human health and due to their large scale spread,

may transform into pandemics and lead to large scale destruction and deaths of human beings (WHO, 2011). Recent Novel Corona Virus Disease of 2019 (COVID 19) leading to a pandemic jolted the existing healthcare infrastructure and facilities in developing countries with adding multifold burden at every level (Emmanuel, Osondu, & Kalu, 2020). Pakistan has been facing the epidemics since its establishment as a sovereign state. Let it be Cholera, Dengue, Measles, Malaria, disaster prone infectious diseases, etc, Pakistan has faced them and has been evolving through them at all times (Wesolowski et al., 2015). It was an opening call and threatening situation towards analyzing why in a country like Pakistan, with poor infrastructure and healthcare budget, third wave of COVID 19 took toll on the nation with death rate surpassing almost 24,000 and patients pool rising above a million (Anderson et al., 2020). With existing system being able to fight back in the first and second wave at a better rate as compared to third wave, it is need of the hour to explore the aspects which have not been addressed in the past during the earlier epidemics faced by Pakistan i.e. Cholera, Dengue, etc and still is missing during the COVID 19 pandemic (Bhatti, Ghufuran, 2020). How can these gaps be addressed and why these have not been identified with focus on the public health at large?

## 2. LITERATURE REVIEW

Epidemics refer to spread of a disease in a large scale population creating a challenge for the existing healthcare system and adding heavy burden to manage and control the spread of the disease (Cronk & Bartram, 2018). It mainly is based on a number of parameters and factors which contribute to the spread and initiation of the spread of disease. These mainly refer to as the changes in the ecological balance of a host population, variation or decrease in the immunity level of the population and introduction of a novel pathogen to the host population or reservoir (Tang, 2015). This phenomenon leads to the exceeding the limits of the threshold balance and hence the pathogen spreads the disease amongst the population. If restricted within one location or region or area, it is referred to as epidemic and when it crosses borders of regions and spread out to continents, it transforms into a pandemic (Sultan & Khan, 2013). Either case, the results are huge scale losses to human life, socio-economic decline and stress on the healthcare infrastructure and system to manage these unwanted circumstances and situations (WHO, 2020).

Pakistan is the 6th largest populated country of the world and 5th most fragile to the climate change disasters and events. It has a mixed healthcare system comprising of governmental, semi-governmental and private organizational setup to run multi-scale healthcare facilities (Khalil et al., 2017). With government spending between 0.4-0.6 % of the budget to the healthcare sector, large scale population has to spend out of their own pocket to opt for healthcare facilitation (WHO, 2019). The national health infrastructure comprises of 1201 hospitals, 5518 Basic Health Units, 683 Rural Health Centers, 5802 Dispensaries, 731 Maternity & Child Health Centers and 347 TB centers, and the total availability of beds in these health facilities is estimated at 123394 (WHO, 2019). Above these, with one doctor to every 1300 patients is critical call to the existing healthcare system further jolted by epidemics and taking to a verge of collapse by recent pandemic (Haqqi et al., 2021).

Pakistan has faced epidemics since its existence. It is one of only three countries on the planet Earth still there to eradicate Polio due to poor socio-ethnic practices further deteriorated by political and geographical factors. According to WHO profile of Pakistan (WHO, 2019), apart from recent pandemic of COVID-19, Pakistan has suffered recently from burden of epidemics like Dengue fever in 2010-11, Cholera in 2010, Avian Influenza in 2007-08 and other related included Tuberculosis, Measles, etc. Pakistan has always been facing these epidemics due to poor health hygiene conditions, poor sanitation, lack of education and training, lack of facilities, lack of trained professionals including epidemiologists, poor prioritization of health by governing bodies, etc (Barzinjy et al., 2021). This poor management based aspects and lack of integration of epidemic provisions have caused death to more than 48 doctors of 58 healthcare workers by the mid of 2020 and the number have risen ever since (Ali, Sadique, & Ali, 2021).

Pakistan nation has been known to be amongst the most generous nations to contribute to humanitarian causes yet epidemics scale is usually so huge that these measures may not match its magnitude (Rasheed et al., 2013). With such an exposure to a large scale broad spectrum of infectious and communicable diseases along with non-communicable diseases, Pakistan would have been able to took the epidemic stance and preparation as part of the overall healthcare system (Rao et al., 2011). However during the recent pandemic multiple waves of COVID 19 and Dengue spread along with it in the year 2020 in Punjab and KPK province, raised a serious gap towards identification of issues and causes which have not lead Pakistan to be able to cope for epidemics though we have been facing it ever since (Hick et al., 2020).

### 3. RESEARCH METHODOLOGY

Based on the defined gap from review of literature, research followed an online cross sectional close ended questionnaire with options to add discussion based on the epidemic preparedness guidelines of World Health Organization (WHO). Its main focus was to explore and access the doctors, nurses, paramedic staff, administrators and allied medical staff to reply the online questionnaire serving in the forefront pandemic or have served previously in an epidemic facility across the nation. Based on the database acquired from the Department of Nutritional Science & Environmental Design offering degrees in Human nutrition, dietetics & health, questionnaire was circulated to 250 targeted respondents amongst which 172 responded which gave it a 68% feedback ratio. The targeted audience mainly were the people serving in the pandemic / epidemic units where they have faced issues associated with poor designing or lack of considerations for the epidemic based issues pertaining to keeping the design minimal for the ongoing regular conditions with any flexibility / provision for transformation. The overall questionnaire was divided into three parts i.e. Personal demographics, Epidemic emergency preparedness related questions and facilities & infrastructure related question along with a section referring to providing feedback in text/discussion relating to any recommendations or suggestions.

### 4. DATA COLLECTION AND ANALYSIS

Data was collected over a period of three weeks starting March, 2021 and concluding in April, 2021. Basic demographics are shown below in Table 1:

**Table 1** – Personal Demographics

S.No	Aspect	Type	Count	%	Type	Count	%
1	<b>Gender</b>	Male	112	65%	Female	60	35%
		Below 25	18	10%	26-35	79	46%
2	<b>Age Groups</b>	36-45	51	30%	46-60	21	12%
		Above 60	3	2%			
		Doctor	41	24%	Nurse	54	31%
3	<b>Profession</b>	Dentist	8	5%	Medical Staff	40	23%
		Allied	17	10%	Admin	12	7%
		Less than 5	33	19%	06 to 10	65	38%
4	<b>Years Experience of</b>	11 to 15	52	30%	16 to 20	19	11%
		Above 20	3	2%			
		5	<b>Serving</b>	Yes	172	100%	No
6	<b>Setting</b>	Urban	106	62%	Rural	66	38%
		Punjab	55	32%	KPK	38	22%
7	<b>Province</b>	Sindh	31	18%	Balochistan	21	12%
		G&B	13	8%	AJK	14	8%

Note: G&B- Gilgit-Baltistan, AJK – Azad Jammu Kashmir

As shown above in Table 1 the major share/percentages to answers are highlighted in grey color, 65% respondents were male and 35% were female with 62% from Urban while 38% from rural settings. Major age group was between 26-35 years (46%) followed by 36-45 years (30%). Professionally respondents representation were 31% nurses, 24% were doctors, 23% were medical staff, allied were 10%, administration were 7% and dentists were 5% . All of the respondents were serving at the time of data collection. 38% had 06-10 years of experience followed by 11-15 years with 30% representation of the respondents as the major group. Based on provinces, Punjab had 32%, KPK had 22%, Sindh had 18%, Balochistan had 12%, Gilgit-Baltistan (G&B) and Azad Jammu Kashmir(AJK) had 8% representation. Based on the epidemic emergency preparedness related questions, details are shown below in Table 2:

## Multicultural Education

**Table 2 - Epidemic Emergency Preparedness**

S.No	Questions	YES	NO	NOT Sure
1	Did your healthcare facility faced any epidemic situation while you were serving in the facility?	100%	0%	0%
2	Did Incident Command group has representation from all major departments?	85%	2%	13%
3	Was there a new emergency communication plan and system of in-house communication for epidemic period implemented?	92%	7%	1%
4	Were OPD, Diagnostics, Emergency, IPD & other functions kept working during epidemic period?	44%	49%	7%
5	Was surge capacity improved to cope with the epidemic situation?	92%	2%	7%
6	Were staff and medical teams given briefing, training and additional support to cope with epidemic?	93%	2%	5%
7	Were logistics and management of supplies, including pharmaceuticals well managed during the epidemic?	62%	38%	0%
8	Were the necessary support services like waste management, infection control, food supply, laundry, security, etc enhanced during epidemic?	65%	15%	20%

Table 2 above clearly shows the major share/percentages to answers in grey color. It is evident that all respondents were serving while their respective healthcare facilities were designated or referred to for epidemic patients. 85% of these established incident command group to engage all departments 92% also improved their emergency and in-house communications to cope up with the situation. Allied departments like Out Patient Department (OPD), Diagnostics, Accident & Emergency (ER), Inpatient Department (IPD), etc were either dedicated to the epidemic patients or were partially closed in 49% of the facilities while 44% kept these departments working. This evidence clearly marks that the facilities were not designed to cope up with the pressure of an epidemic and hence were facing issues of partial departmental closure. In order to cope with the severe circumstances faced in any epidemic circumstances, 92% did improved surge capacity to manage the extreme conditions faced, 93% provided briefing and training related to epidemic disease apart from prior knowledge, 62% were able to improve logistics and supplies while 65% enhanced support services to manage epidemic situation through improving infection control, food supply, waste management protocols, laundry, security, etc. Later questions related to existing facilities and infrastructure were asked to relate the epidemic line of actions with respect to preparedness.

**Table 3 – Epidemic healthcare facilities and infrastructure**

S.No	Questions	YES	NO	NOT SURE
1	Did the facility decided to cater for epidemic patients while also catering allied patients of general illness?	32%	61%	7%
2	Was there a triage facility or separate emergency space designated for epidemic patients or existing facility was used commonly?	49%	49%	1%
3	Were there separate waiting and OPD along with diagnostics and allied support for epidemic patients or commonly used by all patients?	26%	73%	2%
4	Was the epidemic diagnostics done within facility or samples send outside ?	20%	77%	3%
5	Was there a separate medical team designated for the epidemic patients ?	35%	64%	1%
6	Was there any existing or specific ward/s designated for the patients suffering from epidemic agent ?	64%	36%	0%

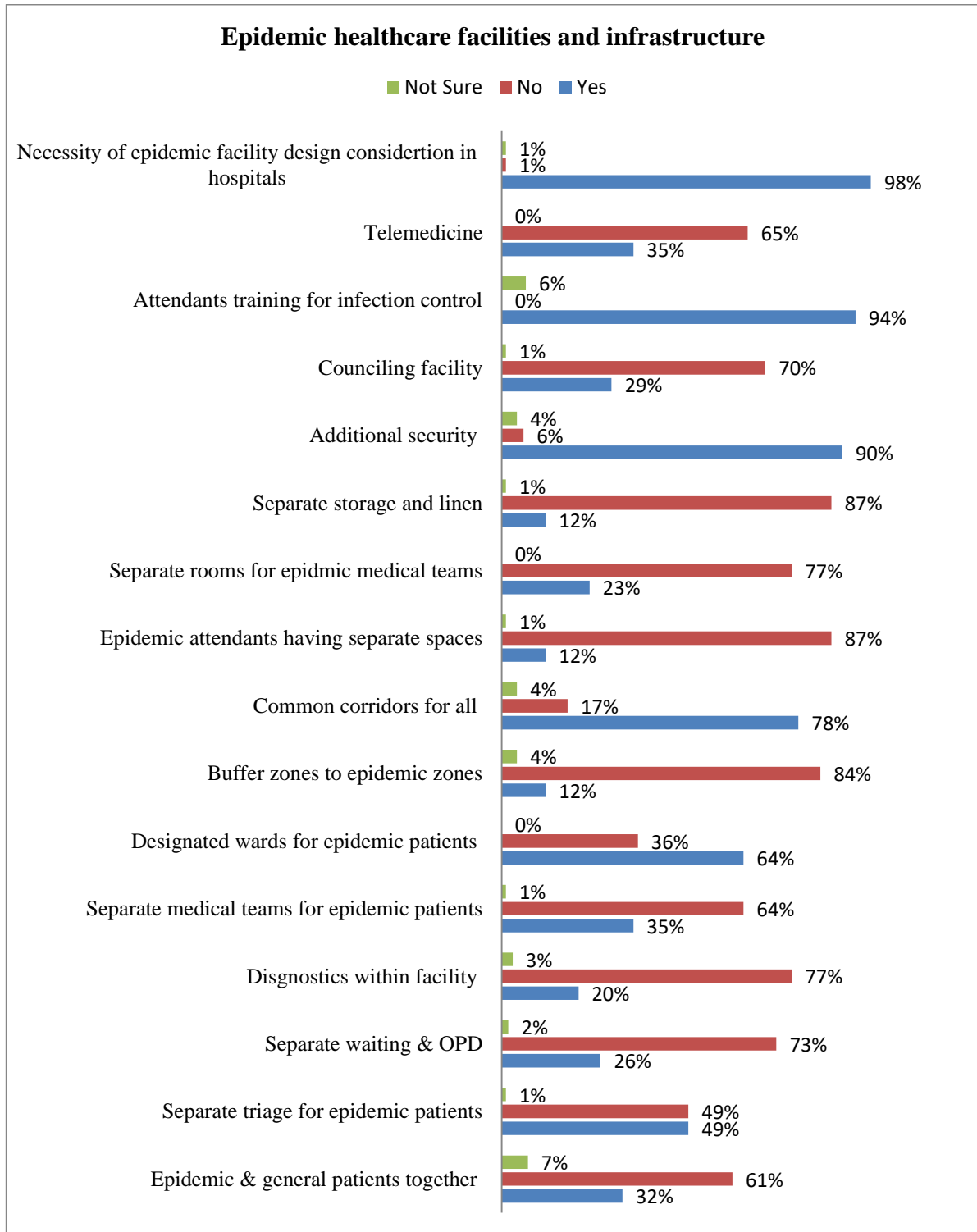
## Multicultural Education

7	Were there any buffer zones added to the circulation to avoid people getting close to epidemic ward/s?	12%	84%	4%
8	Were the epidemic wards accessed using common corridors within hospital for doctors, patients, staff and attendants movement?	78%	17%	4%
9	Were the attendants with epidemic patients given separate spaces or were sharing them in wards and open areas of hospitals ?	12%	87%	1%
10	Were there any separate rooms designated for epidemic medical teams working with epidemic patients?	23%	77%	0%
11	Were there any separate rooms designated for storage facilities including clean & dirty linen and waste management protocols for epidemic ward/s?	12%	87%	1%
12	Were there any additional security provided to these facilities along with surveillance?	90%	6%	4%
13	Was there any counseling, social support and briefing space designated for epidemic patient attendants ?	29%	70%	1%
14	Were the attendants with epidemic patients given guidance & training related to infection control & prevention?	94%	0%	6%
15	Was there any telemedicine facility provided ?	35%	65%	0%
16	Is there a need to consider epidemic facility design when future hospitals are designed/upgraded in context of Pakistan?	98%	1%	1%

As shown above in Table with highlighted grey areas of major percentages, inquiry about healthcare facilities and infrastructure related to epidemic management of patients and their facilitation raised some major concerns. 61% of the facilities stopped their allied functional departments related to OPD and hence created another chaos for the regular and ongoing patients while forced / committed to cater for epidemic patients. It was like 50% of the facilities kept their Accident & Emergency facility (A&R) designated for the epidemic patients creating burden on the allied healthcare facilities in the context bound to receive these patients. Hence the risk of mortality / fatality to these critical care patients increased due to prioritization of epidemic patients in the healthcare settings. Closing of existing ongoing OPD operations lead to designating 73% of these facilities for the epidemic patients though 77% of the facilities sent the diagnostic samples of epidemic patients outside of the hospital.

As shown above in the figure 1, 64% of the facilities designated the existing multi-departmental teams for the epidemic patients and hence these medical facilitators were not only exposed to epidemic patients but to regular patients they were treating as well, risking not only their lives but the others as well. 64% of the healthcare facilities designated wards earlier designated to other departments now taking only epidemic patients. 84% of the facilities were not designed or able to segregate the movement and corridors for the epidemic wards and their designated allied spaces. 87% of the attendants with epidemic patients and 77% of the medical team associated with epidemic patients were not given separate spaces for waiting and retiring spaces respectively. 87% spaces of dirty and clean utility were common for all allied working or operational departments along with epidemic wards and spaces. 90% were bound to increase the security of the facility due to high risk of threat and spread of epidemic to attendants as well as visitors. 70% facilities lacked designated briefing and attendants counseling spaces and since these were previously done in OPD which were now designated to epidemic uses, these critical functions were de-prioritized, though still 94% of the facilities managed to provide guidance to attendants. 65% were able to opt for telemedicine facility but this was recently done during the pandemic time only. 98% of the respondents considered that epidemics must be considered as part of the healthcare facility planning of the future facilities and existing hospitals must be evaluated with respect to epidemic design principles to upgrade where possible.

**Figure 1** Epidemic healthcare facilities and infrastructure



As evident above in the table 3 and its discussion, there are some major gaps here which highlight some of the most critical aspects ignored or miscalculated while designing and planning for the epidemic response and designing of the facilities where these epidemics have to be treated.

### 5. MAJOR CONCLUSIONS

Fighting an epidemic in a developing country can be an extreme challenge due to poor financial and healthcare system. As evident from the data analysis above from table 2&3, closing of multiple OPD and allied departments might be a good cause to limit the spread of the disease yet these measures lead to chaos and create more stress on the allied patients not suffering from epidemic. Following were major conclusions:

1. It was also concluded that half of the healthcare facilities opted to keep separate triage or even Emergency to cater for the epidemic which raises serious concerns that what would happen to those patients who have to be taken to the emergency and are in critical medical state, fighting for survival.

2. With no separate OPD and attendants spaces for the epidemic patients, it was alarming that those who might be in close vicinity may get contaminated/infected as well, since OPD have to be either dedicated or overwhelm with epidemic patients.

3. There were multiple aspects which correlated with one policy and design failure increasing the magnitude of the epidemic, these aspects included lack of buffer zoning, attendants and medical team working with epidemic patients were not given separate spaces or rooms & mostly they are shared, dirty linen and medical waste from epidemic wards were not kept separate rather kept in most of the places at common dirty linen & dirty utility, common corridors with limited control protocols for movement were used and above all 98% of the respondents stated that epidemic aspects and conditions must be considered while designing of healthcare facilities.

4. These all highlighted critically that epidemic considerations were completely ignored at a massive scale and hence have resulted in devastating outcomes. With pandemic time overlapping with forthcoming dengue fever epidemic which may arise around the corner (usually July with monsoon season in Pakistan), it is high time to reconsider the overall design and planning of healthcare facilities in Pakistan with focus and delineation of epidemic planning and design of spaces to incorporate it in extreme conditions and circumstances.

### 6. RECOMMENDATIONS

It is critical that considerations with respect to the epidemic emergency designation to evolve. It is important to identify those healthcare facilities which are central to the city expansions and could be easily accessed based on the multiple modes of transportation including local transportation systems. Priority to be given to those facilities which have better option for future extension i.e. have more open spaces on the building outskirts and perimeter so that it may facilitate in enabling multiple entrances. Preference should be given to private and semi-private rooms accessible on ground or first floor rather than wards. These if located on the sides of the building or corners will also be an added advantage.

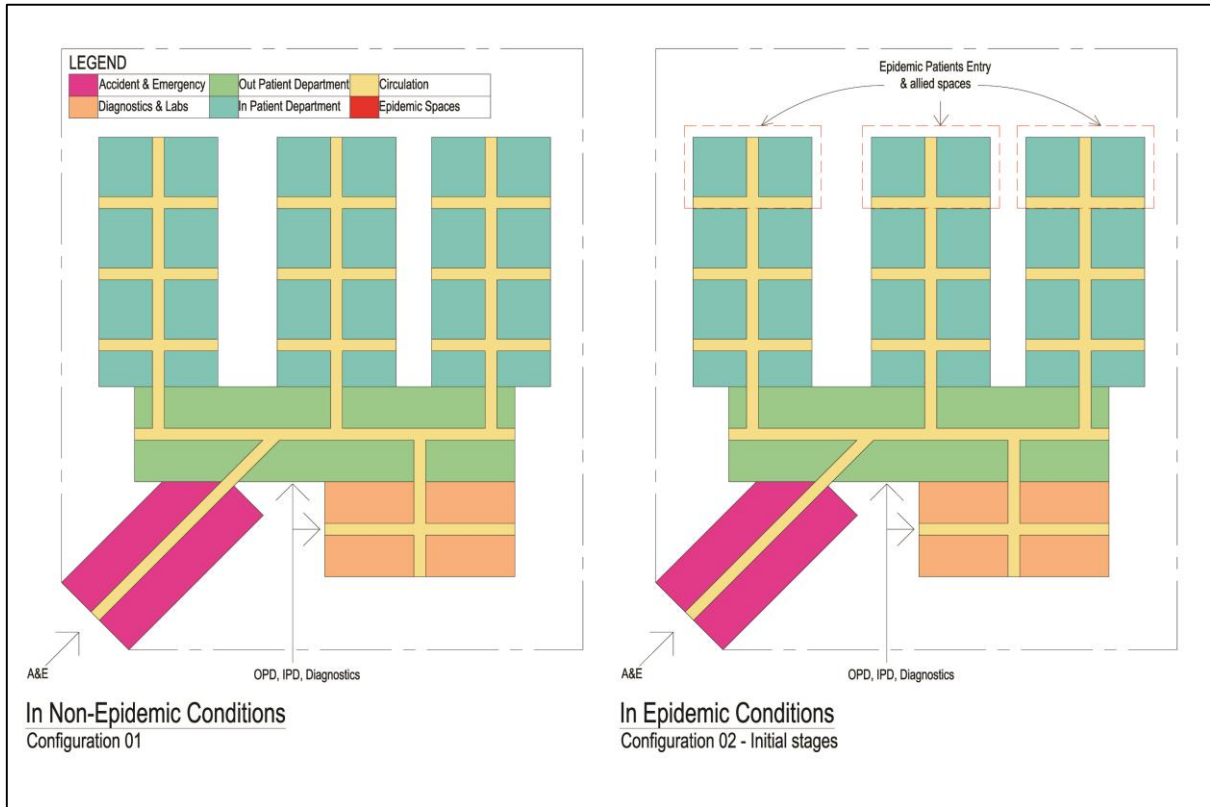
Spaces in the corners and allied access corridors can later be connected to outside providing opening and doors to develop separate access and entrances for epidemic patients and their influx/outflux. Add additional prefabricated structures and spaces to the designated areas to facilitate the working of these critical spaces and isolate these from other hospital functionalities.

Local climatic conditions should be explored inline with these interventions since Pakistan has a very diverse climate and weather patterns. Medical teams designated to the epidemic wards and patients must enter from one designated separate entrance, work for their respective shift and then leave after necessary decontamination process through separate exit door. Hence avoid any intermixing with other spaces, corridors and staff. If deemed necessary, Quarantine and Isolation facilities could also be established through necessary interventions within these spaces.

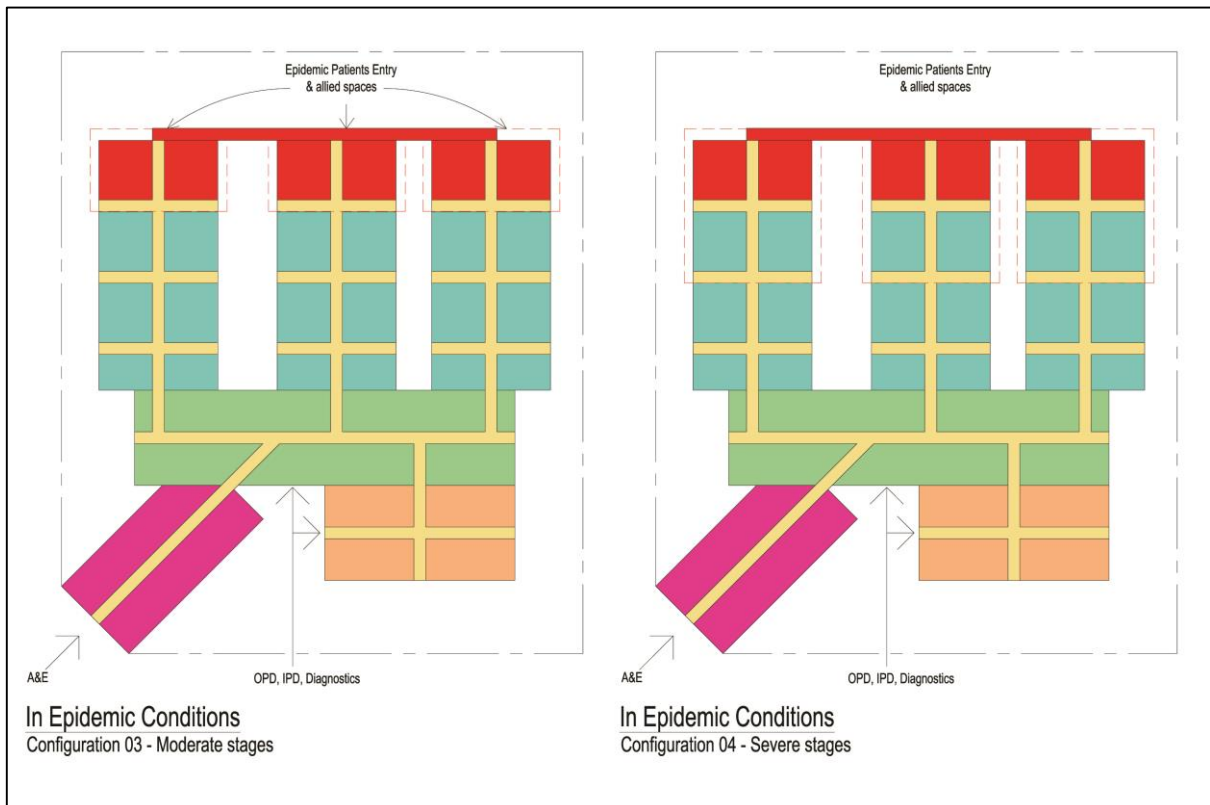
Managing the negative air pressure to ensure there is only outward outflow of air and no coming back inside is the key factor towards success of epidemic facility with respect to infection control. Two air changes per hour are desired (WHO, 2021). Separate electricity and energy system may help improve the efficiency of the facility. Allied spaces related to attendants, counseling, briefing, etc can also be kept separate. In case these provisions are not feasible, either change the hospital choice or opt for a whole separate tent or prefabricated based structure may serve the purpose.

Following below is the diagrammatic representation of the stated above proposed aspects based on the criticality of the epidemic and its multiple stages for a generic hospital or healthcare facility transformation.

**Figure 2** Non-Epidemic condition & Initial Epidemic Stage spaces identification

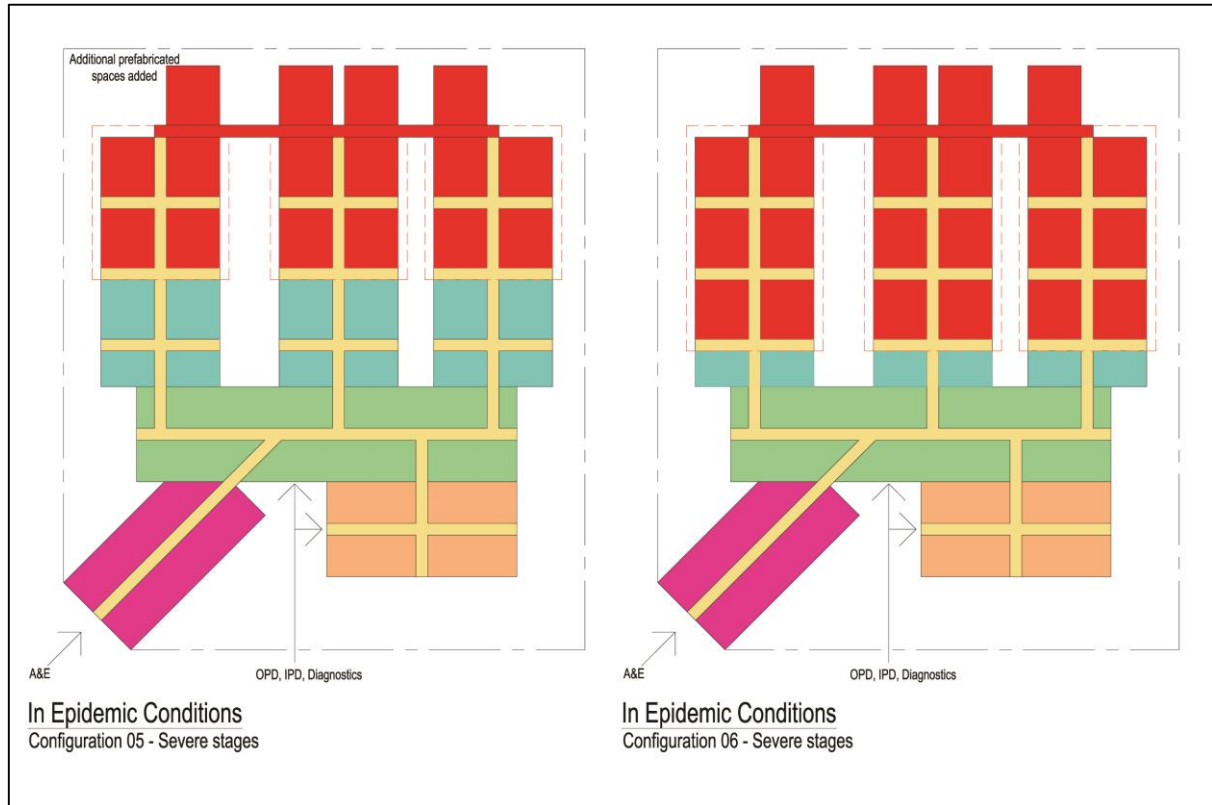


**Figure 3** From initial epidemic stage to moderate and then to severe epidemic stage





**Figure 4** Multiple severe epidemic stage configurations



As shown above in Figure 2-4, initial without epidemic conditions hospital existing configuration starts to change from configuration 01 to 06 based on the need of the epidemic severity. These configurations could ensure that allied hospital services remain intact, working and kept the epidemic based spaces and areas are segregated and separated based on the proposed design interventions. Since it is a generic representation of a hospital without any specified scale, each hospital or healthcare facility may require customized revisions and interventions based on their respective existing architectural & allied engineering & functional design.

## 7. FUTURE PERSPECTIVES

In order to evaluate critically the root cause of the gaps identified, it is need of the hour to explore amongst the architects and healthcare designers in Pakistan to inquire about where this gap evolved of missing the epidemic context from the healthcare design context. There is also a need to explore how existing designated facilities for COVID 19 in Pakistan are evolving spaces and internal configurations to cope up with the existing design gaps under the extreme pandemic conditions. These gaps must also be evolved in respect of designing epidemic based facility design in the context of Pakistan with diverse climatic conditions which should be flexible enough to accommodate non-epidemic conditions as well as severe epidemic or pandemic circumstances enabling better management of infection control, disease management and facilitation of the patients along with medical and allied teams.

## References

1. Ali, I., Sadique, S., & Ali, S. (2021). Doctors Dealing With COVID-19 in Pakistan: Experiences, Perceptions, Fear, and Responsibility. *Frontiers in Public Health*, 9(December), 1–9. <https://doi.org/10.3389/fpubh.2021.647543>
2. Anderson, D. M., Cronk, R., Best, L., Radin, M., Schram, H., Tracy, J. W., & Bartram, J. (2020). Budgeting for environmental health services in healthcare facilities: A ten-step model for planning and costing. *International Journal of Environmental Research and Public Health*, 17(6). <https://doi.org/10.3390/ijerph17062075>
3. Barzinjy, A. A., Aziz, K. F., Hussien, B. M., Qader, S. S., Hamad, S. M., Qader, A. S., & Jamal, A. L. (2021).

- Fear of COVID-19 as a precautionary measure to prevent the epidemic among the population of the Kurdistan Region/Iraq: based on a questionnaire survey. *Zeitschrift Fur Gesundheitswissenschaften = Journal of Public Health*, (May), 1–8. <https://doi.org/10.1007/s10389-021-01568-0>
4. Commission, T. E., & World Health Organization. (2011). Hospital emergency response checklist. World Health Organization, 1–26. Retrieved from [http://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0008/268766/Hospital-emergency-response-checklist-Eng.pdf%0Ahttp://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0020/148214/e95978.pdf](http://www.euro.who.int/__data/assets/pdf_file/0008/268766/Hospital-emergency-response-checklist-Eng.pdf%0Ahttp://www.euro.who.int/__data/assets/pdf_file/0020/148214/e95978.pdf)
  5. Cronk, R., & Bartram, J. (2018). Environmental conditions in health care facilities in low- and middle-income countries: Coverage and inequalities. *International Journal of Hygiene and Environmental Health*, 221(3), 409–422. <https://doi.org/10.1016/j.ijheh.2018.01.004>
  6. Dewar, B., Barr, I., & Robinson, P. (2014). Hospital capacity and management preparedness for pandemic influenza in Victoria. *Australian and New Zealand Journal of Public Health*, 38(2), 184–190. <https://doi.org/10.1111/1753-6405.12170>
  7. Emmanuel, U., Osondu, E. D., & Kalu, K. C. (2020). Architectural design strategies for infection prevention and control (IPC) in health-care facilities: towards curbing the spread of Covid-19. *Journal of Environmental Health Science and Engineering*, 18(2), 1699–1707. <https://doi.org/10.1007/s40201-020-00580-y>
  8. Haqqi, A., Khurram, M., Din, M. S. U., Aftab, M. N., Ali, M., Ahmed, H., & Afzal, M. S. (2021). COVID-19 and Salmonella Typhi co-epidemics in Pakistan: A real problem. *Journal of Medical Virology*, 93(1), 184–186. <https://doi.org/10.1002/jmv.26293>
  9. Hick, J. L., Hanfling, D., Wynia, M. K., & Pavia, A. T. (2020). Duty to Plan: Health Care, Crisis Standards of Care, and Novel Coronavirus SARS-CoV-2. *NAM Perspectives*. <https://doi.org/10.31478/202003b>
  10. Khalil, A. T., Ali, M., Tanveer, F., Ovais, M., Idrees, M., Shinwari, Z. K., & Hollenbeck, J. E. (2017). Emerging Viral Infections in Pakistan: Issues, Concerns, and Future Prospects. *Health Security*, 15(3), 268–281. <https://doi.org/10.1089/hs.2016.0072>
  11. Rao, T. A., Siddiqui, B. A., Shaikh, M. A., Ahmed, M., Shaikh, A. H., & Ahmed, F. (2011). Dynamics of some common epidemics in Karachi, Pakistan. *Journal of the Pakistan Medical Association*, 61(11), 1072–1079.
  12. Rasheed, S. B., Butlin, R. K., & Boots, M. (2013). A review of dengue as an emerging disease in Pakistan. *Public Health*, 127(1), 11–17. <https://doi.org/10.1016/j.puhe.2012.09.006>
  13. Sultan, F., & Khan, A. (2013). Infectious diseases in Pakistan: A clear and present danger. *The Lancet*, 381(9884), 2138–2140. [https://doi.org/10.1016/S0140-6736\(13\)60248-2](https://doi.org/10.1016/S0140-6736(13)60248-2)
  14. Tang, R. (2015). Evaluation of Hospital Preparedness for Public Health Emergencies in Sichuan (China). *Qut*.
  15. Wesolowski, A., Qureshi, T., Boni, M. F., Sundsøy, P. R., Johansson, M. A., Rasheed, S. B., ... Singer, B. H. (2015). Impact of human mobility on the emergence of dengue epidemics in Pakistan. *Proceedings of the National Academy of Sciences of the United States of America*, 112(38), 11887–11892. <https://doi.org/10.1073/pnas.1504964112>
  16. World Health, O. (2021). Infection prevention and control guidance for long-term care facilities in the context of COVID-19: interim guidance, 8 January 2021, (WHO/2019-nCoV/IPC\_long\_term\_care/2021.1). Retrieved from <https://apps.who.int/iris/handle/10665/338481>
  17. World Health Organisation. (2019). Hospital Preparedness for Epidemics. WHO Guidelines, 71. Retrieved from [http://apps.who.int/iris/bitstream/10665/151281/1/9789241548939\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/151281/1/9789241548939_eng.pdf)
  18. World Health Organization. (2020). Severe Acute Respiratory Infections Treatment Centre. World Health Organization Publications, (March), 120.