American Academic Scientific Research Journal for Engineering, Technology, and Sciences
ISSN (Print) 2313-4410, ISSN (Online) 2313-4402
http://asrjetsjournal.org/

Architecture and Infectious Diseases: Setting-Up a Multipurpose Isolation Facility in Nigerian Hospitals

Nurudeen Shehu Barau[a*], Ibrahim U. Hussaini[b], Usman Bukar Wakawa[c]

[a]*B.Tech(Arch), M.Tech.(Arch), Ph.D. in-view(Arch), Department of Architecture, ATBU, Bauchi and P.M.B 0248, Nigeria*

[b]*B.Sc.(Arch), M.Sc.(Arch), Ph.D. (Arch), Department of Architecture, ATBU, Bauchi and P.M.B 0248, Nigeria*

[c]*B.Tech(Arch),M.Tech.(Arch), Ph.D.(Arch)Department of Architecture, ATBU, Bauchi and P.M.B 0248, Nigeria*

[a]*Email: nurabarau@gmail.com,* [b]*Email: hudalib@yahoo.co.uk,* [c]*Email: angilibukar@gmail.com*

Abstract

The high and continuous spread of infectious disease such as Corona virus (COVID-19) has affected public health globally. The preparedness of hospitals in the face of this situation is a problem in the Nigerian context, hospitals were faced with the problems of lack of viral containment spaces to isolate suspected cases and treat the infected patients. This research aims at exploring the design requirements and configurations of a multipurpose infectious disease isolation centre in Nigerian hospitals with a view to develop a framework for setting-up of infectious disease isolation facility in Nigerian hospitals. The research objectives are as follows: (1) To identify the functional spaces in isolation centres of Nigerian hospitals, (2) To determine the principles of configuration and design considerations in setting up of isolation centres in Nigerian hospitals and (3) To develop a framework or a model for the setting-up of IDIC in Nigerian hospitals. The above objectives were achieved through the employment of a qualitative research approach. An in-depth interview was conducted, the data was analysed using the thematic coding analysis. Results from qualitative analysis were reported in tables and narrative report, content analysis was also conducted. The result of the analysis reveals that an isolation centre should be zoned into four parts, namely: (1) Triage, (2) Green zone (safe zone), (3) Yellow zone (Semi-safe) and (4) Red zone (danger zone). The suspect bay should be in single rooms and that no more than one suspected patient should be in the same room. There is need for a molecular laboratory in the facility. There is need for negative pressure rooms for respiratory infections. The use of high efficiency particulate Air-condition (HEPA) is necessary for decontamination of indoor air before discharge. There is also a need for large open space to cater for watery diseases like cholera.

Keywords: Architecture; Infectious Diseases; Multipurpose; Isolation; Facility; Nigeria Hospitals

---

* Corresponding author.

1. Introduction

1.1 Background

The high and continuous spread of infectious diseases such as coronavirus disease has affected public health globally, the entire world came to a standstill with the outbreak of this unprecedented pandemic tagged COVID-19 [1]. This pandemic affected not only human health but also the operational health of businesses and organisations [1]. It is being addressed temporarily at various local and global scales through construction and erection of temporary structures and tents; conversion of public spaces such as hotels, stadia and Office blocks into temporary isolation camps; social distancing measures; as well as compliance to WHO guidelines [2]. SARS-COV-2, The virus that causes COVID-19, is primarily transmitted through droplets and contact routes [1]. However, certain procedures performed in health care settings produce aerosols that may render the virus airborne and capable of spreading over much longer distances. These include nebulizer treatments, suctioning of respiratory secretions, and endotracheal intubation [2].

The world today is witnessing an alarming spread of infectious diseases and this has sparked an extensive research in the field of infectious disease control techniques [3]. This led to the development in the field of infection suppression in order to reduce the spread of diseases. A logical solution to the problem was isolation of patients. Most recent global outbreaks like COVID-19, Ebola, Lassa and Yellow fever have shown that, even though we have advanced technologically, a lot need to be done in the field of containment suppression [4].

This is exemplified by the current COVID-19 pandemic where the appearance of a seemingly limited cluster of cases of pneumonia linked to a sea food market in Wuhan, China Commission (2019) has become one of the worst pandemics in human history with a staggering number of more than 1.4 million infections in 177 countries and more than 85 000 deaths globally as of 9 April 2020 [5]. It is worth noting that only a few of the current 177 countries affected seem to have passed the peak of the epidemic while the majority of these countries are just beginning to see a surge in cases.

As at July 30, 2021, the number of confirmed COVID-19 cases in Bauchi state is 1,551 with 17 deaths, and in Nigeria, there are 172,821 confirmed cases with about 2,167 deaths [6]. Total confirmed cases globally, amounted to 199,466,211 and about 4,244,541 deaths [1]. As the COVID-19 pandemic continues to move at record speed, the speed and volume of the scientific knowledge on SARS-CoV-2 and COVID-19 are correspondingly fast and unprecedented. As of 9th April, 2020, the WHO regularly updated bibliographic database of publications on COVID-19 astoundingly including more than 5300 publications Steffens (2020) of which about 1800 articles appeared in PubMed indexed journals [7].

1.2 Statement of the Problem

The rapid spread of COVID-19 disease has generated a global public health problem and preparedness of hospitals in the face of this situation is a problem in Nigerian context. Currently in Nigeria, public and private hospitals were faced with the problems of lack of viral containment spaces to isolate suspected cases and treat the infected patients as well. The major problem at the moment to both the government, policy makers and

stakeholders is inadequate data on the space requirements and configurations of the functional spaces that could be used in the planning, design, construction and erection of a multipurpose infectious diseases isolation centres to suite our own hospital norms and protocol as well as accommodate various forms of these diseases such as COVID-19, Lassa fever, yellow fever, Ebola virus etc.

1.3 Amand objectives

The aim of this paper is to explore the design requirements and configurations of multipurpose infectious diseases isolation centres in Nigerian hospitals, with a view to develop a frame work of configuration and design consideration for setting-up of infectious diseases isolation facility in Nigerian hospitals. The objectives of the paper are as follows: (i) To identify the functional spaces in isolation centres of Nigerian hospitals before and during COVID-19 pandemic, and (ii) To determine the principles of configuration and design considerations in setting-up of infectious diseases isolation centres in Nigerian hospitals and (iii) To develop a framework or a model for the setting-up of IDIC in Nigerian hospitals.

2. Literature Review

2.1 Introduction

Infection control is emerging as a biggest challenge to health services around the world. All hospitals knowingly or unknowingly admit patients with communicable diseases [2]. In recent years, emerging infectious diseases represent an ongoing threat to the health and livelihoods of people everywhere. Over the last few decades, there have been several emerging infectious diseases (EIDs) that have taken the global community by surprise and drawn new attention to EIDs, including HIV, SARS, H1N1, and Ebola.

2.2 Isolation Room

A High-level Isolation Room (HIR) has been defined as a hospital room provided with negative pressure, with at least six air changes per hour, and an anteroom. We adopted this definition because it accords with international guidelines, and we believed that these features are crucial for effective patient isolation and may represent the minimum requirements for such facilities [8]. Negative pressure is essential for the isolation of patients affected by confirmed or suspected diseases with obligate, preferential or opportunistic airborne transmission (XDR-TB, SARS, human-adapted highly pathogenic strains of influenza virus, smallpox). The presence of an anteroom increases the efficiency of the system, providing an obstacle against pressure loss and reducing the risk of movement of contaminated air into common areas; moreover, the anteroom provides a controlled environment in which donning and removal of personal protective equipment and other infection control procedures can be done safely [8].

2.3 Functions of isolation room

i. To separate patients who are likely to be infectious to other persons.
ii. To provide an environment that will allow reduction of the concentration of airborne particles through

various engineering methods.

iii. To prevent escape of airborne particles from such rooms into the corridor and other areas of the facility using directional airflow.

iv. To protect patients who are immune-compromised from potential harmful pathogens

2.4 Types of Isolation Rooms

There are two types of isolation rooms: (1) Airborne infection isolation (AII) rooms and (2) Protective environment (PE) rooms. The airborne infection isolation (AII)/Negative pressure isolation refers to the isolation of patients infected with organisms spread via airborne droplet nuclei <5 μm in diameter. These include patients suffering from measles, chickenpox and tuberculosis [9]. Protective environment (PE)/Positive pressure isolation is a specialized area for patients who have under-gone allogeneic hematopoietic stem cell transplant (HSCT) [10].

3. Methodology

3.1 Research design and Study area

This refers to the way a researcher applies a logical structure to his research project. The function of this step in the research process is to make sure that the data gathered are sufficient and appropriate for answering the research questions completely and unambiguously [11]. For the purpose of this study, qualitative design approach shall be employed. [12]. The study was conducted at the Infectious Diseases Isolation Facility (IDIF) in Abubakar Tafawa Balewa University Teaching Hospital (ATBUTH), Bauchi, Bauchi state.

3.2 Qualitative method

Qualitative approach enables us to better understand the world, and specifically the people within it. This study was conducted using a qualitative method of research; an in-depth interview was used as a means of data collection. Two (2) participants were interviewed in the isolation centre at different times, and there responses were recorded and analysed.

3.3 Criteria for the selection of respondents and sample size

Purposive sampling was used to select and screen respondents for this study. It is a process whereby the researcher uses judgments (criteria) to select a sample that is most useful for the research. The following criteria were used for the screening of participant for this study:

Profession (Doctor or a Nurse), Years of experience (at least 15years in managing the affairs of an isolation camp), Qualification (for a Doctor not less than a consultant, for a Nurse not less than chief nursing officer), Status or rank (for a Doctor, shall be a coordinator or head of isolation facility, for a Nurse, shall be a manager or in-charge of an isolation facility), Age (to be above 40years), Speciality (for a Doctor must be an infectious disease physician or infectious disease Nurse). It should be noted that the general rule on sample size for

interviews is that when the same stories, themes, issues, and topics are emerging from the interviewees, then a sufficient sample size has been reached. However, for the purpose of this paper, only the coordinator of infectious diseases isolation centre and the manger were interviewed, because of their experience in running the affairs of isolation centre. Generalizations about the results are usually not able to be made because small samples are chosen and random sampling methods are not used [13].

3.5 Instrument for Data Collection

Unstructured interview questions were used to conduct in-depth interview with the coordinator and manager of infectious diseases isolation centre in ATBU Teaching Hospital, Bauchi.

3.6 Data Collection and Method of Analysis

3.6.1 In-depth Interview

The following process was followed for conduct of the interview: plan, develop instruments, collect data, analyze data, and disseminate findings.

4. Data Analysis and Result

4.1 Thematic Coding Analysis

4.1.1 Data management

The first step in the process is to ensure good data management. Following the data collection, the verbatim transcripts of files of the interviews was typed. A mid-way approach was used, that is the use of standard word-processing software, in our own case Microsoft Word, and we cut and shuffle electronically.

4.1.2 Verbatim Transcript and coding the data

The data within each transcript was converted into a manageable form, and brought together. In this case (Microsoft Word), we cut and paste all transcripts together into one file. During data coding: the first stage is to break down or build up the transcripts into manageable paragraphs of perhaps two to five sentences each. A paragraph break was place where there may be a change in direction by the interviewee.

4.2 Content Analysis

This is a word count of regularly used keywords or phrases. Alternatively, this content analysis may be the first part of more detailed analysis, once data has been coded.

Table 1: Content analysis table.

CONTENT ANALYSIS TABLE			
S/NO	KEYWORD	FREQUENCY	REMARK
1.	Isolation centre	25	
2.	Infectious diseases	21	
3.	Triage	18	
4.	Suspect area	24	
5.	Confirmed cases area	23	
6.	Staff	18	
7.	patients	30	
8.	Viral hemorrhagic fever	16	
9.	Cholera	18	
10.	Lassa fever	17	
11.	Respiratory infections	18	
12.	Negative pressure rooms	17	
13.	Laboratory	10	
14.	Diagnosis	18	
15.	Separation	10	
16.	Mode of transmission of diseases	16	
17.	Multipurpose	11	
18.	Principles	18	
19.	Design	18	

Source: researcher's evaluation, November, 2021

4.3 Writing the Narrative Report and Discussion of Result

4.3.1 Data analysis

At this stage, like-coded paragraphs were brought together into new files. In one file therefore, there will be many paragraphs from different interviewees, but all these paragraphs have the same code, such as functional space 'FUS'. You will then reflect with insight; 'what were these interviewees really saying about 'Triage' Using cut and paste or cut and shuffle, or the functions within your data management software, all the data sources that have been allocated the same code were brought together. Within MS Word, a copy of the coded data file was saved, in order to have a back-up in place if needed. Now coded data were reviewed, the content of the codes were read and re-read, which was now termed as themes. What are the aspects of each theme or sub-theme? We refer to notes made when coding, and a new thematic headings was developed.

Do all the statements under the themes agree? Or do they challenge each other? Is something striking in its inclusion or absence? How do the themes relate to the literature? Can you spot ideas that are inconsistent? Do people agree or not? Do people focus on one aspect of a phenomenon or take it to mean various different things? Answering these questions can become a complex and thought provoking process.

Table 2: Analysis table for coded data.

ANALYSIS TABLE
Title of research:
DESIGN REQUIREMENTS AND CONFIGURATIONS OF A MULTIPURPOSE INFECTIOUS DISEASES ISOLATION CENTRE IN NIGERIAN HOSPITALS

Data coding number	Main theme heading	Sub-theme heading	code	Frequency counts	Literature source	Observations, implications or interpretations	Data consistencies	Data inconsistencies
1.	FUNCTIONAL SPACE	Triage	FUS 1	11	African Centre for Disease Control and Prevention (ACDC, 2002).	The importance of a triage in an isolation centre can never be over-emphasize in the identification of functional spaces of an isolation centre	The Triage should be a place of first contact where the patient would be screened before admission, due to the suspicious nature of the symptoms exhibited by the patient	The triage must not be an open space as revealed by the participants, it may be conditioned with HEPA filters, and other mechanical devices
		suspected area	FUS 2	14	Victoria Advisory Committee on Infection Control, 2007.	The suspected case area should be in the form of single room for each patients, and on no account should two patients be in the same room	Suspected patient are usually isolated in single rooms before laboratory diagnosis is out	Suspected patients can leave together in one space after confirmation by their lab diagnosis
		confirmed area	FUS 3	11	Victoria Advisory Committee on Infection Control, 2007.	The confirmed case area, can be in a form of ward for water-borne diseases & contact diseases,	There should be provision for negative pressure & ante-room for respiratory diseases patients	Patients with air-borne diseases can stay within the same room once there is provision for

						but single rooms with negative pressure & ante-room for respiratory diseases	room	negative pressure
		visitors area	FUS 4	1		Provision for visitors can be made, but infection prevention and control most be ensured		
		open space	FUS 5	4	African Centre for Disease Control and Prevention (ACDC, 2002).	There is a need for open space to cater for large population especially for diseases like cholera that patient came in large number	Open spaces are required to cater for large number in the event of any epidemic or pandemic	Open spaces require pipe network for electrical, water and oxygen supply, and there should be floor
		staff area	FUS 6	3	African Centre for Disease Control and Prevention (ACDC, 2002). Victoria Advisory Committee on Infection Control, 2007.	There should be an area for staffs which include their offices, changing rooms, common room, convenien ces, consulting rooms, donning and doffing areas	Provision for staff should be made in order to increase infection prevention and control measure, this include areas where they stay when they are less busy	The staff areas as reveal by the participant s should be divided into two, namely: yellow zone and green zone i.e. areas they can access with PPE and without PPE
		laborator y	FUS 7	3		There should be a laboratory within the		

						centre, this is to fast track the diagnosis and know the result of patient on time for treatment to begin and to avoid travelling a long distance with hazardous sample from patients		
2.	PRINCIPLES OF CONFIGURATION	separation	POC 1	10	Lam *et al*; 2015 African Centre for Disease Control and Prevention (ACDC, 2002). Victoria Advisory Committee on Infection Control, 2007.	There should be no interaction between patient in the suspect bay, until after diagnosis/lab result	Patients must be separated especially in the suspect bay	The separation is to avoid spread of the disease from patient that is positive to patient that may be diagnosed negative
		negative pressure room	POC 2	4	Victoria Advisory Committee on Infection Control, 2007. ECDC, 2020	The pressure in rooms for respiratory patients must be lower than that of other spaces, to avoid air contamination in the whole facility	Rooms for patients with respiratory diseases must have negative pressure and en-suite lobby or ante-room	Negative pressure can be artificial through the provision of Louvre windows
		Zoning of functions	POC 3	8	African Centre for Disease Control and	Isolation centre should be zoned into four, the	Suspected cases must be separated from	Yellow zone to be added as areas that are safe,

					Prevention (ACDC, 2002).	triage(first contact), green zone(safe), yellow zone(partially safe) and red zone(not safe)	confirmed cases and triage as well	but wearing PPE is advised
		Cohort area	POC 4	4	African Centre for Disease Control and Prevention (ACDC, 2002).	For cases like cholera they can be managed together i.e. in the confirmed cases area, so that they can be managed together	This may be in form of open space or a general ward, but it is recommended that each patient should be demarcated for privacy	Each patient should have a small cubicle in a general ward
3.	DESIGN CONSIDERATIONS	HEPA, filters, air ducts	DEC 1	4	ASHRAE standard 55 for thermal condition, (ASHRAE, 2013a); ventilation stand 62.1 (ASHRAE, 2013b). 62.2 (ASHRAE, 2013c) & 170(ASHRAE, 2008 & FGI 2010). Victoria Advisory Committee on Infection Control, 2007.	This are required especially in negative pressure rooms to keep the internal pressure lower than the external one	The whole idea is to prevent patients with respiratory infection to spread the diseases to other parts of the centre	Class-n, class-s, class-p and class-a types of rooms were recommended in the guidelines for isolation of patients with infectious diseases for Australian govt.
		Walls, floors & ceilings	DEC 2	4		Ceilings, floor and walls should be washable and very tight to avoid escape of air to other parts of the centre	The centre in ATBUTH cannot be used for the treatment of patients with water borne diseases like cholera and respiratory diseases	All patients with the three mode of contact of diseases should be accommodated in one complex

							like TB	
		Ventilation, water supply & electricity	DEC 3	4		Electricity, water supply and ventilation system is a necessity in an isolation facility, so that frequent request for services out of the centre would be restricted	Isolation facility cannot operate without adequate water supply, uninterrupted electricity supply and well design ventilation system	Mechanical ventilators, sensor taps and solar and inverter back-ups/UPS are fully recommended in isolation centre around the globe
		Oxygen network and ventilators	DEC 4	5		Oxygen network are required all over the centre because of patients with co-morbidities like high blood pressure, TB etc.	Oxygen network must be provided for illness like COVID-19, as well as ventilators for severe cases e.g SARS COV2	All beds should have provision for ventilators and monitors, not ICU alone.
		Hygiene	DEC 5	4		There should be provision for automatic hand sanitizers all over the centre especially at patient & staff areas	In other to ensure adequate IPAC, all doors should be auto open/handless to avoid contamination & cross contamination, auto-sanitizers should be all through	Provision for bowls and water containers were at strategic points for hand hygiene, a times this causes cross contamination, especially among staff, which may lead to nosocomial infections

4.	Multipurpose isolation	Contact transmission	MU P1	8	African Centre for Disease Control and Prevention (ACDC, 2002)., Victoria Advisory Committee on Infection Control, 2007	Patient with diseases caused by contact transmission can be managed in the centre, but cannot be used for managing water disease and respiratory patients	Patient were isolated at the initial point with no interaction at all and can be managed together after their diagnosis is out	Patients with contact diseases should never be managed together even if their diagnosis is the same
		Airborne transmission	MU P2	8		Provision for negative pressure room is a necessity, with en-suite toilet and anteroom or lobby, sensor doors may be the best alternative	Rooms must be with negative pressure to avoid rapid transmission, patients must be separated irrespective of their diagnosis	Negative pressure can be manual using louvre windows
		Waterborne transmission	MU P3	7		Provision must be made for open space to cater for large number of patient in this case	Temporary structures with water and electricity network are usually erected during emergencies	There should be provision for water proof floors, walls and roofs for easy disinfection and cleaning
		Mode of transmission	MU P4	12		It has been observed that all patient areas for the treatment of respiratory diseases must have negative pressure systems,	Isolation of patients into various categories such as Negative Pressure, Positive Pressure, Standard Pressure and alternate pressure	

							rooms, premised on the mode of transmission (NACIC, 2007), (ACDC, 2002).	

4.3.2 Discussion of result

4.3.2.1 Determination of principles of configuration

The participants really highlighted that "the major principle for configuring spaces in isolation centre is to determine the mode of transmission of the various form or types of infectious diseases". This must be considered when setting-up an isolation facility. The principle in establishing a suspected patients area, should be in such a way that there would be no interaction or physical interaction between patients, so that the disease of one person would not be transferred to the other, because at that point some may be tested negative.. In the area that would be designed for respiratory infections, the respondents reveal "for the confirmed cases, we need another area for respiratory infections such as TB (pulmonary Tuberculosis), the setting of the area should be with Negative Pressure (i.e. internal pressure lower than outside pressure) so that whatever the patient brings or coughs out would be absorbed, would be taken out, it would not go through the windows, ceilings and spread to other areas for respiratory infections". However, for any space to be used for the treatment of respiratory diseases, it must have or be equipped with the facilities of negative pressure to avoid the spread of the disease to healthcare workers and other people around.

Another important aspect of the principle of configuration in isolation centres is that the whole centre must be zoned i.e. must be divided according to mode of transmission, because "the principle of the configuration are based on the status of those cases".

In every isolation centre, there should be like a standard open space for temporary treatment for other diseases that usually comes in number like cholera, because the participant reveal that the maximum capacity of the centre is twenty (20) patients, because for cases like cholera you can have hundreds of patients on admission.

4.2.11 Determination of design consideration

In the aspect of design consideration, the data set reveal that you need to consider certain parameters in an isolation facility. It has been considered very important to have spacious functional spaces to accommodate patients especially now "we have COVID-19 and the recommendation by the WHO is that, there should be at least a metre between one person and another", especially in places like the triage. These spaces should be well aerated, if ventilation is natural there should be large windows, but if it is artificial air duct is more prepared

with exhaust and not ordinary air conditions. High Efficiency Particulate Air filters or Air conditions are more prepared.

Walls, floors and ceilings in isolation centres must be washable and must be tight to avoid escape of air into other spaces and to maintain negative pressure where necessary. For isolation centre to function effectively the participant reveal that adequate ventilation must be ensured and an air change of not less than 12ACH is required in all internal space to be able to flush away all fan matter. Water supply must be adequate and efficient and a reservoir shall be provided for adequate storage. There should be uninterrupted supply of electricity to ensure safety of equipment, air flow and heat ventilation and air filters are functioning effectively. Inventers with solar panel and stand by generators should be provided to serve as backup in case of any power outage within the centre. In setting up an isolation facility the participants reveal that consideration must be made for oxygen network in all patients wards.

The participants also suggest that for the government and other private sector donors to set-up an isolation facility, the following stakeholders should be involved: infectious disease, physicians, respiratory physicians, micro biologists, other laboratory scientist, architects and other building experts such as HVAC consultants.

The design consideration has also been determined, consideration for mechanical ventilation, Heat Ventilation and Air Conditioning (HVAC), hygienic measures, electricity and water supply among others have been taken care of. The types of floor finishes, wall finishes as well as ceiling too has been taken into consideration and all these elements must be re-washable, paint finishes preparably white satin should be applied on all walls, ceiling must be very tight not to allow the passage of air.

It is therefore, in light of the foregoing that the participants consented to share their accounts on the identification of functional spaces, determination of design consideration as well as the principles of configurations of the identified functional spaces. Majority of these perceptions and experiences are in consonance with what was found in the literature and the established theories for this research, although new ideas were discovered and there are inconsistencies in some areas.

5. Summary, Conclusion and Recommendation

5.1 Summary

The significance of isolation facility in the treatment and isolation of infectious patients can never be over-emphasised. This study titled “Architecture and Infectious diseases: Setting-up an isolation facility in Nigerian hospitals” was conducted at Abubakar Tafawa Balewa University Teaching Hospital, Bauchi. The aim of the research was to explore the design requirements and configuration for setting-up a multipurpose isolation centre, with a view to develop a framework for the setting up of an isolation facility. The objectives of the study were to identify the functional spaces in isolation centre of Nigerian hospitals and to determine the principles of configuration and design consideration in setting-up an isolation facility in Nigerian hospitals. A qualitative research approach was employed through in-depth interview with the Coordinator and Manager of Infectious Diseases Isolation facility of ATBU Teaching Hospital, Bauchi. A thematic cording method of analysis was

employed, a recording device was used to record the interview session with the two participants, the recorded data was transcribed, themes were developed and the final coded data was analysed and interpreted. A narrative report in an email form was written, both the coded data that was converted into a table form, somewhat quantitative and the content analysis tables were interpreted; conclusion and recommendation were drawn accordingly.

5.2 Conclusion

The setting-up of an infectious diseases isolation facility would contribute to the fight against infectious diseases in Nigerian hospitals. The need for disease containment spaces in our hospitals cannot be over-emphasised. This research paper was aimed at exploring the design requirements and configuration of multipurpose infectious diseases isolation facility in Nigerian hospitals with a view to develop a framework for setting-up of infectious diseases isolation facility in our hospitals.

The relationship between architecture and infectious diseases has been in existence for so many years. The triage has been identified as one of the major functional spaces in an isolation facility, it is the place where the medical personnel make first contact with the patients, so at that point the patients should be screened and sorted out clearly. The suspect bay is another very important area; you need to separate the suspected patients individually until they are diagnosed of a particular disease. The confirmed areas too should be separated according to the mode of the diseases either contact, airborne and water-borne diseases and the separated areas should have everything that the patients and staff may need. There should be a laboratory within the centre to avoid moving with hazardous samples that may cause spread of diseases within or among healthcare workers. There should be provision for open space to cater for large number of patients in case of any pandemic or epidemic. Provision must be made for negative pressure room in respiratory disease. Section or airborne disease section, floor must be washable, wall finish must be washable too. There should be provision for high efficiency particulate air conditions (HEPA) to decontaminate air within the building. Architects and researchers are continuing to measure the quality of disease. Containment spaces and researchers are continuing to find ways to combat infectious diseases. In the future, it is hopeful that this research will lead to a decrease in infectious diseases in our hospitals, environment and reduce transmission among healthcare workers. If we cannot combat disease containment and transmission of infectious diseases within our society, then we are at risk of high death rate in the event of any epidemic or pandemic. In conclusion, more research and innovation are required to curtail the spread and treatment of infectious diseases.

5.3 Recommendations

The following findings from this research were recommended to stakeholders in setting-up a multipurpose isolation facility for the fight against infectious diseases:

1. Provision of a triage at the point of entry in any hospital. Accident & Emergency, Casualty Unit or Trauma Centre.
2. Separate area for suspected cases, with each patient in one single room until after diagnosis from a

laboratory report.

3. Confirmed cases area to be divided into 3, premise on the mode of the disease i.e. waterborne, airborne and contact disease. Each of these areas should have all the necessary functional spaces that the staff and patients may require.
4. There should be provision for infectious disease and molecular genetics laboratory specifically for the isolation facility.
5. There should be provision for critical care unit, dialysis unit and operation theatre with all the necessary diagnosis tools and examination equipment such as ultra sound machine, X-ray machine and a pharmacy.
6. Areas for patients with respiratory diseases shall be equipped with negative pressure and High Efficiency Particulate Air Conditions (HEPA).
7. Doors and water taps shall be sensored or automatic to avoid cross contamination.
8. All rooms in respiratory disease area shall have anteroom and door to open in-ward.
9. Wall and floor finishes shall be washable and ceiling shall be tightly closed e.g. POP ceiling and lamina floor.
10. There shall be provision for visitors' area, this area shall be sealed with views through glass and verbal communication should be through intercom.
11. All patients' areas shall be under CCTV control.
12. The whole complex shall be divided into four (4): (i) Triage, (ii) Green (Safe) area, (iii) Yellow (semi-safe) zone and (iv) Red (danger) zone and both suspect and confirmed patient areas shall fall under a particular zone listed above

Acknowledgement

I sincerely acknowledge the effort of my Supervisors, Prof. I.U. Hussaini and Dr. B.U. Wakawa for their tireless supervision and guidance; I appreciate them and pray that Allah SWT will bless them abundantly. I sincerely thank the Coordinator and Manager of Infectious Disease Isolation Facility in ATBU Teaching Hospital, Bauchi, for taking their precious time to participate in the study despite their busy schedule, may Allah bless you all.

References

[1]. Organization, W. H. (2020). *Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations: scientific brief, 27 March 2020*. Retrieved from

[2]. 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*, 1-9.

[3]. Dobson, Phillip,Love, Peter (2004). Realist and postmodernist perspectives on information systems research: points of connection, *Australasian Journal of Information Systems, vol. 12, issue 1*

[4]. Guan, Y., Ramesh, A., & Memarzadeh, F. (2014). The Effects of Patient Movement on Particles Dispersed by Coughing in an Indoor Environment. *Applied Biosafety, 19*(4), 172-183.

[5]. Fahmi, I. (2019). World Health Organization coronavirus disease 2019 (Covid-19) situation report. *DroneEmprit*.

[6]. Nigerian centre for disease control (NCDC) "Update on Covid-19 Cases in Nigeria" (July 31, 2021)

[7]. Oniani, D., & Wang, Y. (2020). *A qualitative evaluation of language models on automatic question-answering for covid-19.* Paper presented at the Proceedings of the 11th ACM International Conference on Bioinformatics, Computational Biology and Health Informatics.

[8]. Smith, P. W., Anderson, A. O., Christopher, G. W., Cieslak, T. J., Devreede, G., Fosdick, G. A., . . . Huebner, K. D. (2006). Designing a biocontainment unit to care for patients with serious communicable diseases: a consensus statement. *Biosecurity and bioterrorism: biodefense strategy, practice, and science, 4*(4), 351-365.

[9]. Tang, J. W., Wilson, P., Shetty, N., & Noakes, C. J. (2015). Aerosol-transmitted infections—a new consideration for public health and infection control teams. *Current treatment options in infectious diseases, 7*(3), 176-201.

[10]. Queenan, J. T., Spong, C. Y., & Lockwood, C. J. (2015). *Protocols for high-risk pregnancies: an evidence-based approach*: John Wiley & Sons.

[11]. De Vaus, D. (2001). The context of design. *Research design in social research, 279*.

[12]. Manzano, A. (2016). The craft of interviewing in realist evaluation. *Evaluation, 22*(3), 342-360.

[13]. Farrell, P. (2016). *Writing built environment dissertations and projects: practical guidance and examples*: John Wiley & Sons.

Appendix

Referees

[1]. PROF. ABDULLAHI ABUBAKAR email: abdulubale@yahoo.co.uk, cellphone: 08037036780 Department of Architecture, Ahmadu Bello University, Zaria.

[2]. PROF. YUSUF JIBRIN BARA email: ybjibrin@yahoo.co.uk, cellphone: 08033940611 Consultant Tropical and Infectious Diseases, Abubakar Tafawa Balewa University Teaching Hospital, Bauchi.

[3]. DR. ABDUL A. ISA email: abdulisa60@yahoo.com, cellphone: 08039282889 department of architecture, Abubakar Tafawa Balewa University, Bauchi.

Abubakar tafawa balewa university, bauchi.
data collection instrument. Research paper (interview QUESTIONS)

Architecture and Infectious Diseases: Setting-up a Multipurpose Isolation Facility in Nigerian Hospitals

Dear Sir/Madam,

This research is part of the requirements in partial fulfillment for the award of Philosophy Doctor (Ph.D.) in Architecture at the Faculty of Environmental Technology, Abubakar Tafawa Balewa University, Bauchi (ATBU, Bauchi).

Aim and Objectives of Research

This research aims at exploring the design requirements and configurations of a multi-purpose infectious diseases isolation centre in Nigerian hospitals, with a view to proffering a frame work for the setting-up of isolation facility/centres in Nigeria.

The objectives of the research are as follows:

1-To identify the functional spaces in isolation centres of Nigerian hospitals before and during COVID-19 pandemic.

2-To determine the principles of configuration and design considerations in the setting-up of infectious diseases isolation centres in Nigerian hospitals.

3-To develop a frame work or a model for the establishment of infectious diseases isolation centres in Nigerian hospitals.

The interview questions consist of FOUR (4) sections:

Section A: Student's information

Section B: Introduction and key component.

Section C: Questions.

Section D: Closing and other key components.

All information given will be kept with utmost confidentiality and it is for educational purpose only. Your cooperation and time will be highly appreciated in responding to this interview questions. Thank you.

Section a: student's information

Name: SHEHU, Nurudeen Barau

Programme: Ph.D. Architecture,

Department of Architecture,

Faculty of Environmental Technology,

Abubakar Tafawa Balewa University, Bauchi.

Email: nurabarau@gmail.com

Cell phone: +234(0)703 771 4177, Alternate cell phone +234(0)701 383 6476.

Advisor(s) Name: Arc. (Prof.) I. U. Hussaini

Arc. (Dr.) B.U. Wakawa Ph.D.

Section b

Table 3

Section	Subject	Description of activities
Section b	**Introduction and key** **Components:** • thank you • your name • purpose • confidentiality • duration • how interview will	I want to thank you for taking your time to meet with me today. My name is **shehu, nurudeen barau** and i would like to talk to you about your experiences participating in the diagnosis and treatment of patients with infectious disease in infectious disease isolation camp of atbu teaching hospital, bauchi. Specifically, as one of the components of our overall research investigation, we are exploring the parameters and design considerations in terms of spatial requirements and configurations for the design and planning of infectious diseases isolation centre, in order to curtail the spread and enhance the treatment of infectious diseases in nigeria, africa and the whole globe and to capture lessons that can be used in future interventions. The interview should take less than an hour. I will be taping the session because i don't want to miss any of your comments.

	be conducted • opportunity for questions • signature of consent	Although i will be taking some notes during the session, i can't possibly write fast enough to get it all down. Because we're on tape, please be sure to speak up so that we don't miss your comments. All responses will be kept confidential. This means that your interview responses will only be shared with research team members and we will ensure that any information we include in our report does not identify you as the respondent. Remember, you don't have to talk about anything you don't want to and you may end the interview at any time, without any penalty or loss of benefit. Are there any questions about what i have just explained? Are you willing to participate in this interview? _____ _____ _____ interviewee witness date _____ Legal guardian (if interviewee is under 18)
	Questions 1. • no more than 19 open-ended questions	**Research question 1:** what are the functional spaces required in isolation centers in nigerian hospital? **Research objectives 1:** to identity the functional spaces in isolation centres of nigerian hospitals. 1. What are the functional spaces required in an isolation centre? Please list. 2. Which of these spaces (listed in 1 above) do you consider key functional space in the planning and design of an isolation facility? Please explain. 3. To what extent did the unavailability of these spaces hinder the

	• ask factual before opinion • use probes as needed	functionality of an isolation facility? Please explain. 4. How do you determine the sizes of functional spaces of an isolation centre? Please elaborate. 5. What are the factors to be considered, when expanding functional spaces in an isolation facility in the event of any epidemic or pandemic? Please list.
Section c	**2.**	**Research question 2:** what are the principles of configuration and design considerations employed for the setting-up of isolation centres in nigerian hospitals? **Research objective 2:** to determine the principles of configuration and design considerations employed for the setting-up of isolation centres in nigerian hospitals? 1. What are the underlying rules or ethical standards for arranging functional spaces in an isolation facility? Please list. 2. What strategies would you recommend to be sustained and or scaled up? Please justify. 3. Did the principles conform with who & cdc protocols and guidelines for establishing an isolation facility? Please explain. 4. Are these principles yielding efficacy in the current fight against infectious diseases, such as lassa fever, covid-19, yellow fever and others? Please elaborate. 5. Base on your experience of working in an isolation facility, could you please suggest some areas where these principles need to be improved? Please list 6. what are the factor or circumstances that restrict the design of isolation centres in nigerian hospitals?

		please list and elaborate. 7. How does these parameters or variables determine the success of establishing an isolation facility? Please explain. 8. Are these factors in conformity with that of who & cdc protocols? Please explain. 9. Suggest areas you think improvement can be made, in order to enhance the viability of these parameters in the establishment of isolation centres in nigerian hospitals. 10. what are the factors that are deemed necessary in term of design consideration in establishing an isolation facility? Please list and explain. 11. How do these factors help in the design of an isolation facility? Please elaborate. 12. What are the factors that hinder the implementation of these design considerations? Please list and elaborate. 13. What strategies would you recommend to ensure the implementation of these design considerations? Please list and elaborate. 14. Suggest the stakeholders that you think, can be involved in the establishment, planning and design of an isolation facility? Please list and elaborate.
	Closing and key **Components:** • additional Comments • next steps • thank you	Is there anything more you would like to add? I'll be analyzing the information you and others gave me and presenting a progress seminar to the faculty and my department after the analysis. I'll be happy to send you a copy to review at that time, if you are interested. Thank you for your time.

Section d		