# The role of architectural design in raising the efficiency of temporary Infection Isolation to deal with epidemics as an alternative to public hospitals palaces

**Ahmed Salah Eldin Shiba**

Assistant Prof. of Architecture– Faculty of Engineering – Beni-Suef University, Egypt

**Rasha sayed**

Assistant Prof. of Architecture– Faculty of Engineering – M.S.A University, Egypt

**Abstract**

**The research reviews the proposal of establishing temporary infection Isolation units in dry, hot areas with fast to implementation at a low cost that benefits from the nature of the climate. This will help in preventing the transmission of viruses among parts of the building through buffer areas with certain temperatures, humidity, and atmospheric pressure. Stressing the importance of the role of the architect in raising the efficiency of medical research projects by design. With a review of global experiences in this regard and the future of medical research projects considering the technological progress that allows medical services to reach patients at their homes, which limits the need for permanent health projects. This is considered an impediment in front of the capabilities of countries to face epidemics, which requires experiences in the speed of establishing temporary health infection Isolation units to cope with epidemics. Which necessitates the design of units with special specifications aimed at low cost, speed of implementation, and lack of environmental impacts when they are demolished. Stressing the importance of the architectural design relationship with the efficiency of the infection Isolation units.**

**Keywords: Infection Isolation – efficiency of temporary - architectural design - public hospitals**

**Research problematic:**

Technology progress allows the transfer of the medical service to patients' homes, which reduces the importance of establishing permanent hospitals in the future. However, pandemics preparedness requires a large number of isolation beds, but it’s becoming a burden on the countries after eliminating the epidemic, which requires a solution to face these problems especially among the poor countries

**Research Importance, Hypothetical, Objective, and Methodology:**

The research assumes that the possibility of establishing patients' homes with low-cost materials and speed of implementation such as buildings in the sands can solve this problem because we can remove these units easily once the epidemic has passed. This epidemic without any negative effects on the environment.

The importance of research relies in representation of the big importance to overcome the spreading periods of epidemics which requires infection Isolation units with low-cost, speed of implementation and demolish with easily or change activity.

The objective of research is to provide a solution for poor countries ’governments to overcome epidemics. While the methodology is to follow two main approaches to review the research problem and achieve the its goals, namely. Descriptive Approach through a review of previous experiences with quick implementation, low cost isolation units**.** Deductive approach by devising appropriate solutions for countries in hot climatic regions and using the climate as a component of reducing the spread of the virus.

## I. INTRODUCTION

The design of healthy projects considered one of the most difficult architectural projects due to the importance of separating movement paths and users and the multiplicity of needs and requirements of users in addition to the need to isolate a part of patients to prevent the spread of infection. (Bolin, 1993)13 This criterion is considered one of the most important criteria for the quality of the project's efficiency in its performance and it gets the most important during periods of epidemics and infectious diseases, as hospitals that observe this standard become one of the most important hospitals. (Ashrae, 1989)6 People who have a sufficient number of highly efficient isolation hospitals can be able to escape epidemics. (Greene, 1998)23 It imposes on the architect considering basic aspects to achieve isolation and reduce the spread of infection among users, patients, and workers. Given that hospitals are high-cost projects due to the high cost of equipment and requirements for their operation and maintenance, it is necessary that the design contributes to reducing those costs while achieving the highest quality and efficiency in its performance (Ashrae, 1982)5. This is the goal of research seeks to achieve by presenting the role of the architect in designing a health isolation hospital at a lower cost and a higher efficiency with the introduction of methods of establishing temporary health isolation units at low costs and to be constructed in a short time as well as removing them after eliminating the epidemic at a low cost and with less environmental damage to the demolition waste.

In general, hospital buildings follow multiple health and building standards and regulations and consider a range of economic, social, and cultural factors in the environment in which they are built, making them one of the most complex buildings. (Bologna, 1997)14 It includes places for performing surgeries, as well as departments and laboratories to diagnose diseases and others to detect patients, hospitals must take into account the various developments that occur in the health fields, whether from the organizational, health or therapeutic aspects of the medical machinery and equipment. (Phillips, 1993)42 Therefore, hospital buildings must go through study and analytical stages before starting design and construction and determine the various decisions that precede the design, construction, and operation. In addition, hospital buildings must be environmentally friendly, and their buildings must adapt to different uses, developments and space changes that affect the buildings and are affected by them, and be flexible enough to allow the development of buildings Where necessary, this requires the architect to understand these aspects in order to be able to design a project capable of performing, thus earning the architect a major role in the design of medical research projects. (Greene, 1998)23

### 2- The importance of the architectural role in medical research projects:

The architect represents a major role in the design of medical research projects, as the nature of these projects requires finding solutions many problems that must be avoided in the tracks of movement and separating multiple uses. Hospitals are at the forefront of those projects that require a major role in the design stage and before it the stage of preparing the architectural program.

### 2.1 The Architect's Role in Hospital Design:

The architect's role in designing and implementing hospital building projects can be summarized into several tasks: (Clark, P. 2006)16, (AIA, 2005)49

2-1-1 Cooperating with various parties in defining the strategy of establishing the hospital. These bodies consist of partners who are involved in the construction process and others outside the construction process, such as the residents and the local health authorities.

2-1-2Preparing the space organization of hospital components to achieve comfortable uses in receiving patients and their companions, providing spaces with human and appropriate measurements for work, and specifying the relationships among them so that they achieve a natural direction of movement (the movement of patients, visitors and workers), and provide convalescence and enhance the chances of recovery and achieve a comfortable healing environment.

2-1-3 Preparation of a spatial design that takes into account the movement of patients first in the light of the functional divisions and the physical limits of the services, and it must design the technical base (operating departments and heavy medical equipment .. etc) being the center of the hospital and so that it is open for use by specialists and to serve the geographical area in which the hospital is located, The technical base must also be linked to emergencies and provide emergency services.

2-1-4 The design must consider the provision of ambulance services, mobile treatment services, and secure treatment for patients and chronic conditions wherever they are in the geographical region served by the hospital. Doctors inside and outside the hospital.

2-1-5 The design should be based on creating a design with recurring units that are capable of development as a result of the constant need for change and continuous reuse of buildings, in the light of the continuous development of health sciences and therapeutic techniques, as well as to increase the demand for health services in terms of the continuous increase in population numbers and the continuous development as well in methods Life.

2-1-6 In this regard, the architect must consider finding solutions to what hospital buildings can go in the future by finding mobile treatment services, or when hospital services are dispensed, the building shifts from its job as a hospital to harboring other office or hotel jobs. etc.

2-1-7 The architect must search for new organizational solutions to develop and improve health work in hospitals. For example, in university hospitals where educational buildings are linked to therapeutic and research buildings, these three functions can be combined into one building through a design that takes into account this integration, and provides each job with all its needs.

2-1-8 The architectural design of hospitals must consider reducing the carbon footprint of buildings, whether direct or indirect. To achieve this, from the beginning of the design, consideration must be given to:

2-1-8-1 Choose a suitable location for the project land, choose the locations of the buildings above it, and choose the implementation methods that reduce the impact of this footprint on the surrounding environment.

2-1-8-2 Providing clear movement (vehicles and pedestrians) that facilitate directing for different activities and saves travel time

2-1-8-3 Take into account the provision of healthy natural and industrial lighting and the possibility of choosing building materials and thermal and sound insulation that are available in this footprint.

2-1-8-4 Take into account the design of the outer shell of hospital buildings to provide economic environmental solutions.

**2-2 preparing the architectural program for the hospital project:**

The preparation of the architectural program for the hospital project is considered one of the most important stages of the project, and therefore the program preparation must precede the creation of a circle of research and discussion with the aim of integrating the project with its environmental environment and strengthening internal integration and harmony with the culture of the users around it, taking into account the figuration of a structural system in which priorities are arranged according to a hierarchy Depending on its importance, programming is done through 3 phases: defining objectives, defining and identifying the various components and data for the project, evaluating the components and data based on whether the data are confirmed or not confirmed. (AIA, 2005)49

Generally, there are 4 essential design parameters that must be considered when preparing a hospital project program:

2-2-1 Functional determinants: It is concerned with the activities, services and uses that the programmer must define to develop a human and material organizational structure for everything related to users and visitors to the building.

2-2-2 Urban determinants: Architectural and technical, considering the necessary needs to secure the design and implementation of the hospital, whether it is a new project or rehabilitation.

2-2-3 Legal and organizational determinants: They relate to all precautions that must be taken for the safety and security of buildings, including building codes and codes, fire protection, labor laws, and all regulations and standards related to the operation of each hospital division.

2-2-4 Economic determinants: They relate to strict control of project cost control, starting with programming, design, implementation, and operation

A fifth determinant, the sustainability parameter, which can be added to each of the above four parameters, can be added. Therefore, preparing a health project programming requires the assistance of several experts and agencies, and it should not be prepared by one side or one official. Studies at the programming stage aim to reach the determination of sizes, areas, quantities and demand for each department or sector, as the treatment departments and users determine the number of employees The area of each section, its details, etc.

Programming also defines graphics that regulate the spatial relationships between different functions and drawings that regulate the movement of different flows of vehicles, infantry, and paths of materials (administrative materials, nutrition,

waste), and all these elements follow in assessing their importance, value, and their relationship to each other standards and regulations that are set by different agencies Responsible for the health sector. In the programming stage, the site on which the project will be established is studied, and the urban laws and regulations that the project will be affected are identified. An analytical study on the environmental data of the site and what sustainable requirements the project must fulfill is also prepared. (Clark, P. 2006)16

### 3- The future of medical research projects:

With the beginning of the information age., many jobs were developed, some of them disappeared, and the vacuum needs of many of them changed, which is now taking place in medical research projects where it is expected in the future not to need many medical care projects or dispense with hospitals by establishing mobile units to be transferred to the patient, which confirms the research hypothesis The necessity of finding alternatives to permanent hospitals with high costs, which can be discussed in the following points:

### 3.1 The evolution of contemporary health therapeutic methods:

At the present time, the health-based and hospital-building entities seek to reduce the treatment period for patients inside hospitals, due to the high cost of treatment, and as a result of advances in treatment methods that contribute to expediting the recovery of patients. The medical development has led to the development of new equipment and methods that help to quickly detect Diseases, but equipment and methods that pay for more treatment. The development in the devices included the development of CT scans in particular that determine the precise place for surgical intervention, and current anesthesia and recovery methods have helped to speed the recovery of patients, and all these improvements will help in the possibility of increasing the frequency of treatments and surgeries within hospitals. Also it resulted in healthy development and the evolution of contemporary ways of life and increase the proportion of older people to the population, and the development of chronic diseases, to re-examine the development of methods of treatment outside of hospitals limits. The external therapeutic services have developed to follow up patients in their homes and there is the possibility to provide daily treatment for patients with chronic diseases for short periods inside the hospital, after which these patients can continue their normal lives for the rest of the time and return to their homes, which may help to increase the chances of recovery from a psychological point of view. (Johnson, S. W, 2010)33

As a result of helping not to move patients between the therapeutic and diagnostic units, it is preferable to group the medical and surgical departments in one place. In the past, these departments were designed in separate buildings according to each specialty, and they may be in separate locations in the city or in separate buildings within hospital sites, today it is preferable to group them in one place, which requires reconsideration of the internal distribution of these health functions to ensure clear traffic and transport Patients among them easily and easily, which saves a lot of time and seems to save energy as well, and increases the efficiency of treatment through common services.

On the other hand, it is noted that relying on modern informatics and collecting information and patient files in electronic information systems helps to transfer the patient's information very quickly, and it can save time and energy and help patients' comfort.

These major causes and developments in the health field led to the need to review the design of hospitals and the role and shape of buildings and find appropriate space solutions for this new medical climate, which generally aims to review the numbers and type of beds (prefer the rindividual rooms ) in hypnosis departments, as it aims to Reconsider the therapeutic technical departments that include heavy equipment, operations, emergencies, treatment and diagnostic units, and outpatient clinics. All of this aims at saving investments and building and operating costs in hospital buildings so that the architectural interest in designing hospital buildings has become aimed at creating a quantitative and survival balance between the heavy-tech departments and the therapeutic departments and between the sleeping and reception departments and their facilities. (DGNB. 2013)50

### 3-2 Future directions for health services:

The researchers emphasize that in the future therapeutic methods should spread and increase the number of small therapeutic units and dispensaries that can work to diagnose diseases and treatments through communication via smart electronic means.

In the year 2050 AD, the therapeutic units are expected to spread to be closer to patients in cities and regions, and their therapeutic capabilities will be strengthened through smart communication with the major health centers where medical experiences exist and in which doctors can communicate with patients and learn about their pathology, due to The fact that doctors and health professionals naturally prefer to work in city centers where salaries, allowances, and high advantages are

available, though these modern means of communication will allow these doctors to test the centers in which they hope to work, and that mini centers be established in remote areas where treatment operations depend on the use of specialists through Intelligent communication. (DGNB. 2013)50

This solution will provide the doctors with the advantages that they hope to obtain, and will enhance the comfort of patients so that there will be no need for them to be transferred or to travel to major health centers with high medical services. They are economic solutions to provide all medical specialties and their means in time and space.

It is also expected that the home will be the treatment center and not the hospital through conducting awareness first and health protection second.

Currently 3D images (Holograms) can be transferred and detected on the body's organs through communication networks, in addition to the cultivation of control cells inside the bodies to detect diseases, monitor chronic conditions or measure blood pressure ... etc. Diagnosis of diseases through these means can lead to the treatment of many patients inside their homes, especially children, and the ease of reassuring parents about their children quickly and identifying their health condition.

These trends are only examples of the need to review the design of hospital buildings in a deeper and more accurate way than was used by architects in the past. (Johnson, S. W, 2010)33

### 3-3 Expected development of future hospitals:

In light of the technical progress, it has become certain that hospital projects, especially the public, are heading towards lack of need, which leads many countries and investors to refrain from establishing them, so hospitals await a different future that depends on mobile and specialized units in a large way.

## 4- The previous experiences for infection Isolation units:

The countries of the Middle East competed to sign medical research projects agreements, and a figure (1) among the most important countries in the Middle East during ten years from 2005 to 2014 demonstrates, which confirms the interest of these countries in the medical research system and notes through the graph the remarkable progress achieved by the Kingdom of Saudi Arabia since 2011.

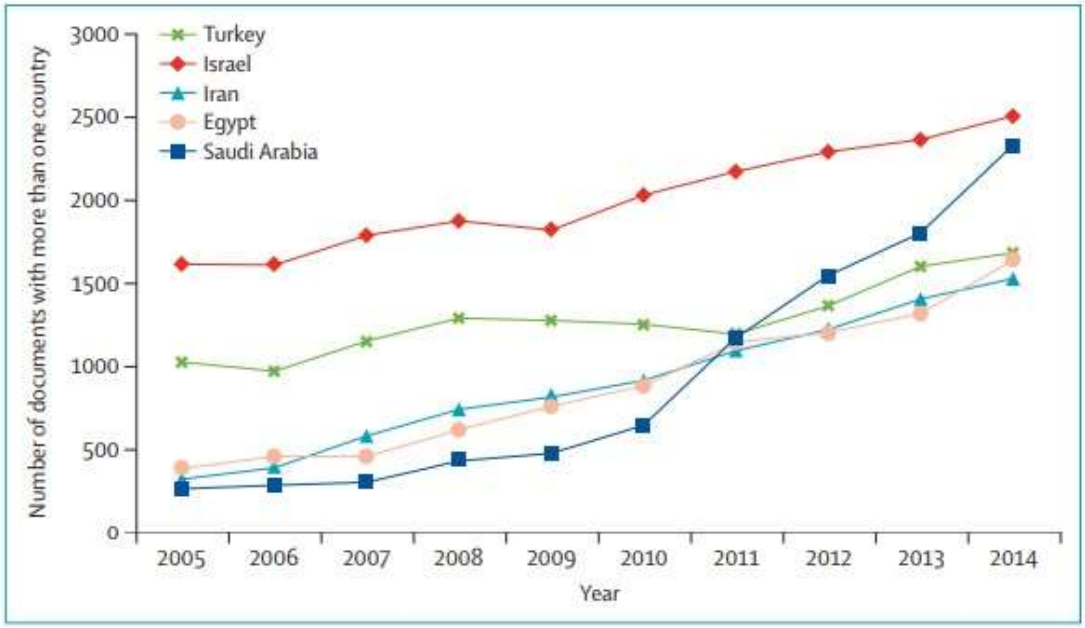


Figure (1) International collaboration in medical research projects for the top five countries in the Middle East source (b). https://albenaamag.com/2016/03/30/

**5- Basic specifications of health isolation temporary units:**

One of the most important health requirements for hospital buildings is health safety, is the necessity of taking all precautions and structural means to prevent pollution, microbial outbreaks and avoid infection inside hospitals, and the need to apply the concept of sterilization and sanitary isolation to patients, as a result of what is happening today from the resistance of microbes and viruses to drugs.

One of the common ways of spreading respiratory viruses is by touching with hands, especially by workers during the treatment of patients, as well as ways of spreading that are caused by the wrong design, which may cause pollution to the internal environment of buildings and what they contain of fixed or mobile elements, such as furniture, walls, treatment tools, bed covers ... etc. Or mobile, such as air, especially the air transported through air-conditioning appliances and channels, or inside storage facilities, or through the external moving curtain cabinets. Among the most important departments that may be affected by these contaminations are operating rooms, radiation, critical cases rooms, laboratory analysis and drug preparation. There may be building materials that emit gases that cause diseases or cancer such as some glue materials for floors or some materials with granular configurations, and the damage can come from liquid materials used in cleaning or those used in analysis laboratories, or from gases used in heating machines Or air conditioning. In general, waste of all kinds, whether medical or organic, and the materials that are washed and reused, such as sanitary ware, bed sheets, bed linen, different garments, etc. (Mirhashemi, 2016)1

Therefore, the design must consider the identification of areas with accurate environmental control, areas that emit pollution and areas with normal uses that do not need control or a healthy classification. Generally, the health safety process should be concerned with treating air, water, wastewater, rainwater, and waste. Health safety is also concerned with electrical energy and safety of medical gases.

The temporary isolation units design depends on two main principles first one is the patient health and safety, second principle is the efficiency thrift of all used resources. At the same time, the designer should pay an effective role in rationalize spending in cost and areas in direct way by designing progressive conceptual designs and using effective sustainable materials. Or in indirect way through helping some other experts in different disciplines, control the efficiency and overcome future problems in different phases of the project. In addition to using recent developed means in preparations, effective cost, and suitable diversity in functionality. To understand the behavior of the isolation health units and be able to design one, we must understand its temporal, economic, functional, and environmental factors. (Mirhashemi, 2016)1

**5-1 Temporal factor**

The design should guarantee effective building time, the proposed design could be built in max 10 days, as there is an urgent need for speed control in time of virus and pandemic. In addition, the dismantling of the building after the end of the pandemic should be in a short time to and with no effects on the environment or no toxic materials. (DGNB. 2013)[50]

**5-2 Economic factor**

The internal architecture of temporary emergency spaces realizes the user's economic values when it achieves the highest functional value and the economy is not limited to cost only. Saving time, effort, and the organization optimization of the space and from are vital elements to achieve design economics that depends on theories, facts, and social conditions to serve utilitarian purposes, the combination of design and economics logic. The designer's role in facing the economic problem in design is determined by knowing the demands, desires, and priorities of the design in relation to the user needs and methods, these requirements are summarized as follows: (DGNB. 2013)50

5-2-1 Reducing the total cost of space by selecting highly available and economical raw materials, which reduces the cost of manufacturing and construction.

5-2-2 Availability of modularity, simplicity, and accuracy in designing parts of the emergency unit, which reduces the number and time of operations to achieve an economic balance between the form and function. Parts functionality of emergency components units design and economy is essential in aesthetic appearance by choosing the most appropriate lines and colors.

5-2-3 The ability to disassemble and re-install, which allows multiple and effective exploitation of the unit, with durability and longevity, considering the flexibility and multiple use of spaces that achieves reciprocity without the conflict between the various functions.

### 5-3 Functional factor

The designer's role in creating a design system to exploit the limitations of space on one side and increasing numerical absorptive efficiency on the other side is highlighted by taking into account some of the design requirements for emergency spaces which are summarized as follows:

5-3-1 Provides a space that fits design and allows easy and comfortable performance of basic activities.

5-3-2 The appropriateness of the design of the unit to considerations of structural measures and kinetic behavior during the practice of various activities within these spheres and considering psychological needs and the behavior of individuals.

5-3-3 Flexibility, reciprocity of use, and multiple use of blanks, relying on flexible multi-purpose furniture units with ease of kinetic performance and the possibility of exploiting vertical expansion in the furnishing.

5-3-4 Coordinate and organize the elements inside the space, while calculating the spaces inside the design to give a feeling of roominess.

5-3-5 Providing natural lighting throughout the day through windows and industrial lighting at night, while achieving visual comfort, achieving vision extending from inside to outside, and providing a healthy climate inside the unit, considering good ventilation factors. (Mirhashemi, 2016)1

### 5-4 Environmental factor

The impact on the environment should be monitored daily in such projects, used materials should be natural to guarantee the clearance of the impact on patient and environment. In addition, all waste materials should be treated in a sustainable way (the proposed model is created from earth natural materials, after pandemic the buildings could be demolished and restored as earth materials with no impact on the environment).

## 6- Basics of architectural design for health isolation units

Temporary emergency hospitals share same specifications with largely permanent ones, but to counter a specific virus additional consideration are considered. First zone should be the zone of installation which is the first input facing a disaster. This space including operations room, waiting area, consulting room, summary surgery. This place as medical office is preventing to disaster and sure patients, satellite health care office that support to herb medical treatment of next step.

Phase 2 is to add X-ray & ICU unit room, examination room, its waiting area, emergency area, laboratory, radiology, patient transferee, triage and operating room which is connected to first zone satellite room that already existed. In addition to inquest area, morgue, and inpatient area. Next table is illustrating the main components of the phase 2.

| Name of the zone | Operating Room | Laboratory | Radiology | ICU unit with beds | Patient Transfer | Triage |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Specifications | -Lead plate for outer surfaces<br>-Dark room<br>-Hematology analyzer<br>-Automatic bath equipment<br>-X-Ray patient table<br>-Lighting<br>-Roof and wall with good insulation<br>- Antibacterial PVC floor<br>-Power distribution panel<br>-Power generator | Biochemistry analyzer<br>-Hematology analyzer<br>-Blood gas analyzer<br>-Cabinet for kit<br>-Binocular microscope<br>-Lighting<br>-Roof and wall with good insulation<br>- Antibacterial PVC floor<br>-Power distribution panel<br>-Power generator | -Lead plate for outer surfaces<br>-Dark room<br>-Hematology analyzer<br>-Automatic bath equipment<br>-X-Ray patient table<br>-Lighting<br>-Roof and wall with good insulation<br>-Antibacterial PVC floor<br>-Power distribution panel<br>-Power generator | -Cabinet for ICU with 4 beds<br>-Roof and wall with insulation<br>-Power distribution panel<br>-Power generator | -Cabinet for ICU with 4 beds<br>-Roof and wall with insulation<br>-Power distribution panel<br>-Power generator | -Cabinet for ICU with 4 beds<br>-Roof and wall with insulation<br>-Power distribution panel<br>-Power generator |

Table (1) describes the relation between each zone and its specification in the isolation hospitals. http://oxycare.com.tr/field-hospitals/

Figure (2) shows a real site ISO container for field hospitals that contain 30 beds with area of 65 x 36,7 meters. http://oxycare.com.tr/field-hospitals/

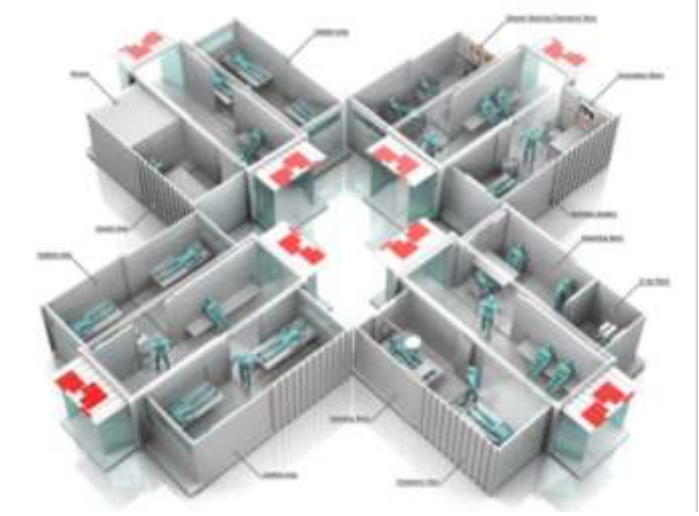

Figure (3) shows a design for emergency by Kukil Han using the containers with a slight of horizontal extension 2011. https://www.coroflot.com/hankukilbo/MOBILE-HOSPITAL#

Different ideas were developed to guarantee the sustainability of the project and clean air with atmosphere inside and surrounding the temporary hospitals. The hospital could have specially designed with special ventilation systems, the air

pressure inside the rooms is negatively designed to prevent microorganisms from being airborne out. The rooms may also be designed with double-sided lockers that connect them to the corridors, allowing hospital staff to deliver supplies without entering the patient's rooms.

Most of the materials used deal with the chemicals that are used extensively for hygiene and sterilization reasons. The water network and drainage did not connect to neighboring infrastructure, but rather to separate networks.

For example, is (Xiaotangshan) Hospital, which was built in Beijing in six days to confront SARS in 2003, for example, was grouping or dividing patient wards based on the level of risk they posed.

In the pattern of Ebola hospitals, the hospital was designed to have two checkpoints, one "dirty" and the other "clean", and the latter will be on the side of the crew that was not injured, while the suspect or confirmed to be injured on the other barrier, a distance of not less than a meter and a half between those was taken into account Barriers, to avoid virus transmission, and aerial photos of the site-transmitted facility show long, rectangular wards connecting to the central axis, then a second smaller set of structures separate from it, for the same reason.

Disinfection areas are also positioned as a separator between the wings and the command and operation center, to reduce the risk to healthcare providers. It was necessary to determine the movement of patients inside the hospital and at the same time taking into account their need to move, especially to the toilets. Therefore, it was necessary to think about the space between the patients, the corridors, facilities, and erecting barriers between them, as well as placing clear signs of movement on the entrances and exits.

## 7- The role of architectural design in achieving safety and Infection Isolation

One of the importance of health requirements for the hospitals' buildings is health safety that means take every precaution and construction ways that include pollution prevention and widespread the microbes to prevent infection in hospitals. It shall apply the concept of sterilization, and infection Isolation for the patients resulting in what was going on in today including antimicrobial and viruses for drugs. (AIA, 2005)49

One of the common ways of spreading respiratory viruses is by touching with hands, especially by workers during the treatment of patients, as well as ways of spreading that are caused by the wrong design, which may cause pollution to the internal environment of buildings and the fixed or mobile elements they contain.

There may be building materials that emit gases that cause diseases or cancer such as some glue materials for floors or some materials with granular configurations, and the damage can come from liquid materials used in cleaning or those used in analysis laboratories, or from gases used in heating machines Or air conditioning. In general, waste of all kinds, whether medical or organic, and the materials that are washed and reused, such as sanitary ware, bed sheets, bed linen, different garments, etc.

Therefore, the design must consider the identification of areas with accurate environmental control, areas that emit pollution and areas with normal uses that do not need control or a healthy classification. Generally, the health safety process should be concerned with treating air, water, wastewater, rain water and waste by all means. Health safety is also concerned with electrical energy and safety of medical gases. (Clark, P. 2006)16

### 7.1 Isolation room design

The design of the Isolation room must observe special conditions that guarantee the insulation between the outside and inside the room through an intermediate space and there are many models of the Isolation rooms to achieve this goal figure (4).

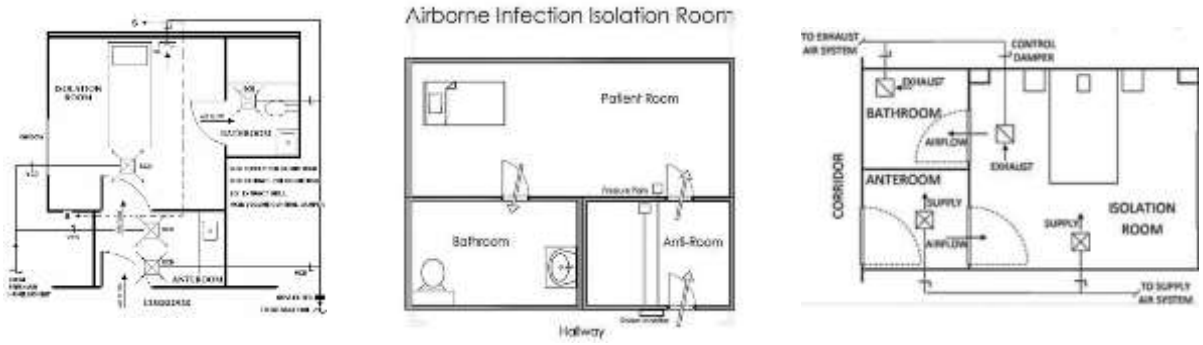


Figure (4) different examples of airborne infection isolation rooms. https://albenaamag.com/2016/03/30/

### 7-2 Using air pressure for infection Isolation

Air pressure resulting from heating the air between 70 - 75 degrees Celsius is used in the isolation rooms, in addition to a humidity between 30-60%. Together both air and humidity create an environment that helps in limits the spread of virus and disease in the middle of the isolation rooms. Therefore, in the proposed design, it is important to have this intermediated space with air and humidity as shown in figure (5) at the same time before each patient room, it is necessary to create a sanitization room with the same technique of air / humidity isolation.

Both rooms and air space around the isolation rooms, are connected to a central building that gather around all the isolated rooms with the shape that helps in complete segregation and isolation from outer air. In addition, the isolation rooms are covered with glass to help in maximum air heat as shown in section figure (7,8) to provide the maximum amount of sterilization while the intermediated space controls the heat temperature in/out isolation rooms.

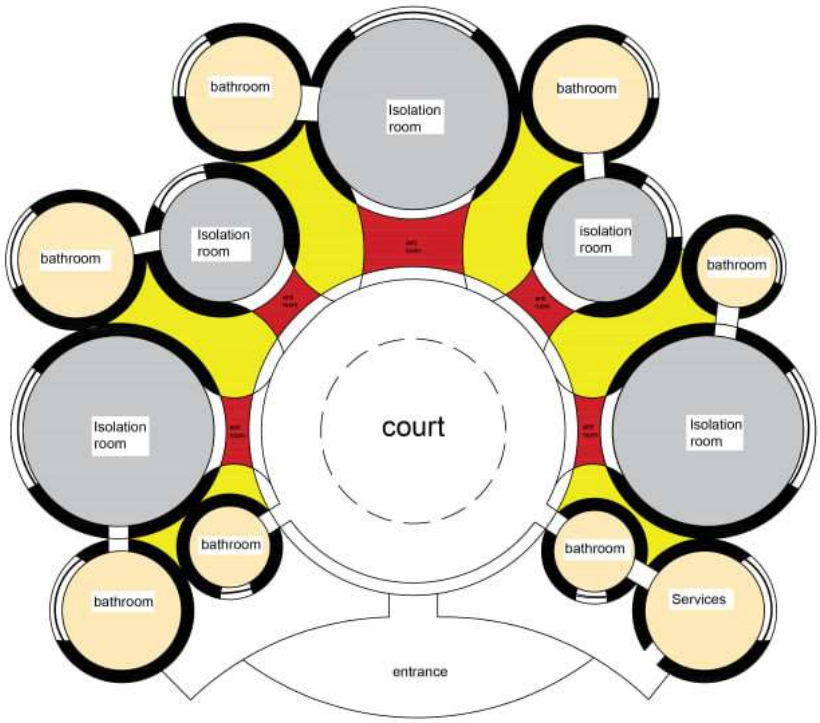


Figure (5) the master plan for isolation units showing the sterilization (services) and its relation to isolation rooms and the intermediated space in between. (Author, 2020)

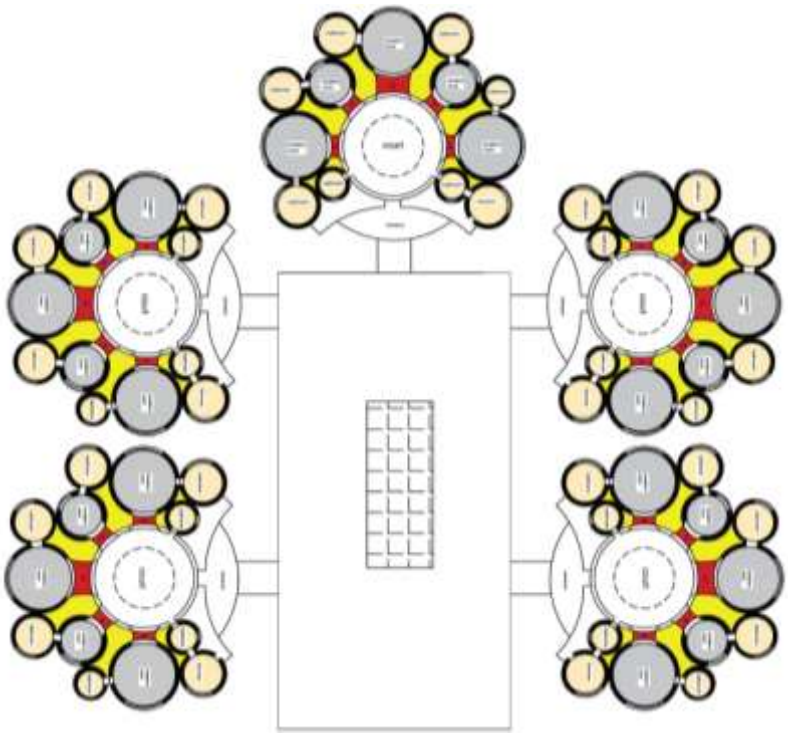

Figure (6) the master plan for group of isolation units with administration in the middle space built also with the same techniques of earth bags or joined rammed earth. (Author, 2020)

In general, the hot weather is great help and potential in controlling the pressure and air temperature which help in decreasing the spread of viruses, in addition the heat helps in sanitization the medical equipment, medical crew and the visitors. The concept is to use the climate resistance in limit the spread of the viruses, toxics, and diseases inside the .isolation units

Figure (7) shows that the voids resulting from the collection of circular voids are used in the figure (8) as areas to raise the air temperature to help limit the spread of viruses through the air temperature, which provides a continuous fresh air that is not transmitted to the infection.

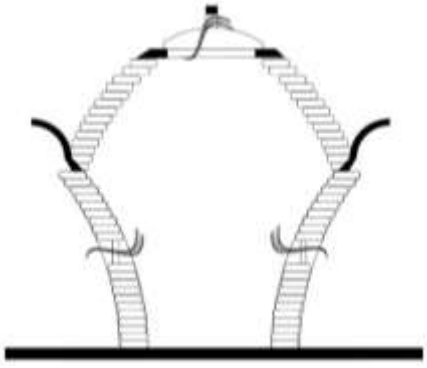

Figure (7) show section in isolation room.
(Author 2020)

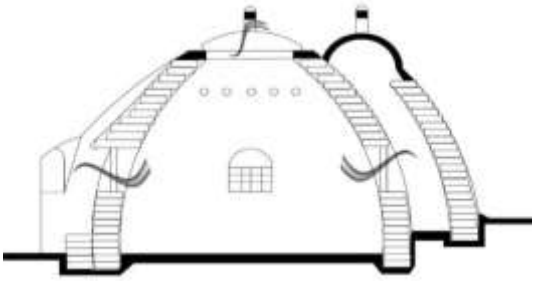

Figure (8) show section in control area.
(Author 2020)

## 8- Proposal for a temporary infection isolation unit:

By reviewing the role of architectural design in medical research projects, the importance of this role in raising the efficiency of projects can be assured through design, as the study of the future of health projects confirms the trend towards refraining from establishing public and large hospitals and moving towards mobile and specialized projects

Through these two points, it is shown that confronting epidemics requires a proposal that deals with the future and uses the architectural design to reach the highest efficiency to enable countries, especially the poor ones, to overcome periods of epidemics and the shortage of public hospitals. Therefore, the proposal to establish temporary infection isolation units came as an alternative that allows preparing places for the injured in a quick time and at low cost, which is available in a proposal to create temporary infection isolation units from available local materials, cheap and fast to implement.

### 8-1 Structural elements for infection isolation unit:

The structural elements of the infection isolation unit consist of simple raw materials locally available that meet two basic conditions: low cost and fast implementation. The structural elements can be divided into two elements, the walls, and the ceiling. Simple local materials can be used in both as follows:

#### 8-1-1 Walls:

The walls are built from sand that is placed in bags of reinforced plastic and well-integrated. The construction is preferred in a circular shape so that no angles are formed which allows continuous air movement to prevent the accumulation of germs as the circular construction supports the building structurally.

Figure (9) group of photos for the progress in walls build up using earthbags technique (Author 2016, project in Egypt)

#### 8-1-2 Ceiling:

The Ceilings are a skylight that can be executed from several materials, whether from sand bags and its top is covered with transparent materials to allow light to enter and the exit of hot air in the figure (10) or it is carried out from a metal structure wrapped in a wire mesh that is covered with a shell with leaving the skylight for the exit of air and the entry of light in the figure (10) or it can Metal structure voids are filled with empty bottles to achieve the same goal and give the ceiling a beautiful

Figure (10) group of photos for the progress in ceiling build up using earthbags and glass bottle technique (Author 2016, project in Egypt)

### 8-2 Architectural finishes for infection isolation unit:

The architectural finishes which are used in the isolation unit, consisting of simple local materials and fast to and low-cost implementation methods commensurate with the economic capabilities of poor countries.

### 8-2-1 Wall finishing:

The internal conch of the walls is done after installing a mesh wire to ensure the conch holds tight on the plastic bags. Then the wire is Spatter dash with a layer of conch and left to dry. Then the internal conch is used as the same method is used for the outer walls.

Figure (11) a photo shows how the walls are finished used conch (Author 2016, project in Egypt)

### 8-2-2 Finishing Skylight:

A metal frame shall be installed on the side of the openings, then it will be surrounded and the installation of both windows and doors made of simple local materials as shown in the figure (12).

Figure (12) shows the work for skylight finishes. (Author 2020, project in Egypt)

### 8-2-3 External finishing:

Finishing can be done in more than one way to give the exterior the appropriate appearance for the isolation units to look as if it were an environmental hotel with a local character, which deserves a set of goals in the forefront of providing psychological support to patients by being in a hospital resort in addition to the possibility of using the unit for other purposes after the end of the epidemic.

Figure (13) shows the finishing works for the complete unit. (Dabaieh, M., 2012)17

### Results:

1- Architectural design represents a great importance in the design of health care projects, as it can by raising the efficiency of the project and contributing to achieving its goals.

2- The future of health care projects in light of the technological progress is directed to the specialized and mobile projects for the medical service to arrive at the patient's home in light of the progress of social media, which leads to the stop of the patient going to receive the service.

3- The high cost of establishing permanent health care projects in light of the possibility of service reaching patients at their homes has led to the reluctance of investors and countries to set up mega projects to accommodate large numbers.

4- Failure to set up mega projects creates a perilous risk for people in the event of epidemics and the need for large numbers of isolation rooms at one time.

5- Poor countries should use the available resources of local materials and the nature of the climate to achieve maximum prevention of epidemics and provide isolation rooms for their poor citizens in a quick time.

6- Establishing temporary isolation units with a suitable external appearance, which can be reused for another activity after the end of the epidemic.

7- Vernacular architecture in the hot arid climate zones always having the solution for achieving the optimum sustainable techniques in all different functional buildings.

8- Hospitals or temporary infection health care units could be a role model for creating a new paradigm of temporary resilient, sustainable buildings.

9- Earthbag and related techniques sufficient in achieving the environmental control basics inside infection temporary health care units with all-natural materials that could be re-used again after finishing the target function of these units.

## Recommendations:

1- Carrying out more research on low cost, fast construction methods.

2- Carrying out more research on the ability of climate in hot regions to limit the spread of viruses.

3- Encourages architects and researchers to integrate advanced vernacular techniques that are using natural materials with natural environmental methods to achieve the efficiency, comfort, and function inside buildings.

4- Cooperating with all involved parties governmental and non-governmental in fixing a new paradigm that enables designers and related bodies to face current pandemic in an efficient, sustainable circle.

5- Using nanotechnology to produce low-cost building materials capable of adjusting the air temperature to the limits that limit the spread of viruses.

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