NEAR EAST UNIVERSITY

INSTITUTE OF GRADUATE STUDIES

DEPARTMENT OF INTERIOR ARCHITECTURE

ADAPTING HOSPITAL INTERIOR ARCHITECTURE PROCESS TO TECHNOLOGICAL ADVANCEMENT IN THE MANAGEMENT OF PANDEMIC CASES IN JORDAN

PH.D. THESIS

SAEED HUSSSEIN ALHMOUD

Nicosia

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APPROVAL

We certify that we have read the thesis submitted by SAEED HUSSEIN ALHMOUD titled **"ADAPTING HOSPITAL INTERIOR ARCHITECTURE PROCESS TO TECHNOLOGICAL ADVANCEMENT IN THE MANAGEMENT OF PANDEMIC CASES IN JORDAN"** and that in our combined opinion it is fully adequate, in scope and in quality, as a thesis for the degree of PhD of Interior Architecture.

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I hereby declare that all information, documents, analysis and results in this thesis have been collected and presented according to the academic rules and ethical guidelines of Institute of Graduate Studies, Near East University. I also declare that as required by these rules and conduct, I have fully cited and referenced information and data that are not original to this study.

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Abstract

Adapting Hospital Interior Architecture Process to Technological Advancement in the Management of Pandemic Cases in Jordan

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Pandemic has been one of the largest worldwide challenges. Since a recognised solution to pandemic has not developed, all countries around the world had to devise self-adopted methods promoting different ways to conduct a series of clinical analyses on cases. Hence, it has become very difficult to generate the number of people that were infected, treated, or deceased. Jordan's approach in pandemic management may serve an essential purpose, but it does not provide a lasting solution to the problem in case of any other unforeseen outbreak of other diseases. This study aims to revise the current pandemic hospital design technological advancement in the management and provide a 3D proposed module design standard procedure that will alleviate the current and future pandemics. This study covers a combination of approaches through personal observations, questionnaire surveys, descriptive statistics, correlations, and regression models. BREEAM green building criteria were used in the assessment of four case studies on hospital buildings, which resulted in an "unclassified" assessment score. The research findings concluded that there has been a considerable upward increase in the number and level of adoption of technological advancement in hospital space. Consequently, this study provides comprehensive process instructions for any fatal virus through the detailed photos and diagrams, hence it is highly recommended to use the content as part of any guidelines that would be required to fight against any current or future pandemics.

***Key Words**:* Pandemic; technological advancement; hospital design; design process; design strategies; BREEAM

Özet

Ürdün'de Pandemi Vakalarının Yönetiminde Hastane İç Mimari Sürecinin Teknolojik Gelişmelere Uyarlanması

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Pandemi dünyanın bugüne kadar yaşadığı en büyük zorluklardan bir tanesi olmuştur. Yaşanan duruma karşı herkesin kabul edeceği bir çözüm geliştirilmediğinden, tüm ülkeler vakalar üzerinde bir dizi klinik çalışma gerçekleştirirken kendi yöntemlerini geliştirmek durumunda kalmıştır. Bu nedenle de hastalıktan etkilenen, tedavi edilen veya hayatlarını kaybeden kişi sayılarını belirlemek de bir o kadar zor olmuştur. Ürdün'ün pandemi vakalarının yönetiminde sergilediği yaklaşım temel amaca hizmet etse de beklenmeyen herhangi bir hastalık salgını olması durumunda kalıcı bir çözüm olarak kabul edilememektedir. Bu çalışma, salgın yönetiminde mevcut pandemi hastaneleri tasarımlarını teknolojik ilerlemeler ışığında güncellemeyi ve gelecekte yaşanabilecek pandemi deneyimlerini kolaylaştıracak bir 3D modül tasarım standardı prosedürü sunmayı amaçlamaktadır. Çalışma, kişisel gözlemler, anketler, tanımlayıcı istatistikler, korelasyonlar ve regresyon modelleri gibi birçok yaklaşımı kapsamaktadır. Hastane binaları hakkındaki dört durum çalışmasının değerlendirilmesinde BREEAM yeşil bina kriterleri kullanılmış ve "sınıflandırılmamış" bir değerlendirme sonucu elde edilmiştir. Araştırma bulgularına göre, hastane alanlarında teknolojik ilerlemelerin uygulanmasında ve genel olarak sayısında önemli bir artış vardır. Sonuç olarak, bu çalışma detaylı fotoğraflar ve şemalar üzerinden herhangi bir ölümcül virüs hakkında kapsamlı işlem talimatları sunmaktadır ve bu nedenle de mevcut veya gelecekte yaşanabilecek herhangi bir salgın durumunda geliştirilecek kılavuzların içeriğinde kullanılması önerilmektedir.

***Anahtar Kelimeler**:* Pandemi; teknolojik gelişme; hastane tasarımı; tasarım süreci; tasarım stratejileri; BREEAM

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LIST OF ABBREVIATIONS

SARS-COV-2:	Severe Acute Respiratory Syndrome Coronavirus
WHO:	World Health Organization
MERS:	Middle East respiratory syndrome
HAIs:	Healthcare-Associated Infections
IAQ:	Indoor Air Quality
SQM:	Square Meters
CDC:	Centres for Disease Control and Prevention
HVAC:	Heating Ventilation and Air Conditioning
IEQ:	Indoor Environmental Quality
ICU:	Intensive Care Units
NHS:	National Health Service
PFI:	Private Finance Initiative
NHS:	National Health Service
EBD:	Evidence Based Design
BREAM:	Building Research Establishment Environmental Assessment Method
COVID-19:	Coronavirus Disease 2019
IT:	Information Technology
ATLAS:	Abbreviated Test Language for All Systems
SPSS:	Statistical Program for Social Sciences
SQM:	Units / Square Meters
UPS:	Uninterrupted Power Supply
DF:	The Degrees of Freedom in the Source
R:	Correlation Coefficient

CHAPTER I

Introduction

Towards the tail end of 2019, the city of Wuhan (Hubei, China) witnessed the emergence of several cases of some pneumonia related pandemic conditions (Cao et al., 2020). After series of medical diagnosis on samples from the lower respiratory tract within the subsequent few weeks heading into January in 2020, a newly formed and evolved virus named Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2) was identified to be the causative agent of the deadly virus whose subsequent deadly impact was yet to be identified by (Chan, Wong, & Tang, 2020; Cortegiani, Ingoglia, Ippolito, Giarratano, & Einav, 2020; Gordon, Tchesnokov, Feng, Porter, & Götte, 2020). The Director General of the World Health Organization (WHO) Dr. Tedros Adhanom Ghebreyesus proclaimed the infection as "Pandemic" on the 11th of February and fast-forward to exactly a month after, similar cases have been experienced in about 114 countries all over the world leading to over a hundred and eighteen thousand cases plus over 4000 deaths, thus leading the WHO to term the state and general effect of the disease pandemic (Huang et al., 2020, Koven, 2020).

Unfortunately, till this present moment in time, a generally accepted standard response method has not been arrived at, thus leaving countries around the world to devise self-adopted methods for tackling the pandemic. This has allowed for the existence of different ways of carrying out a series of clinical analyses in cases. This has effectively made it difficult to obtain a comprehensive number of people affected, treated, or lives lost as a result of this pandemic.

Due to the unexpected arrival of the pandemic disaster cases, countries have resorted to modifying or better still restructuring existing structures such as existing hospital buildings, and residential and office facilities, to accommodate the pandemic patients during these desperate times. Later, temporary hospital structures were formed quickly in Jordan and were used to treat the affected patients, but the building was not well designed to handle the cases and fight the virus. Building a process and effective policies will also play a very important role in fighting pandemic virus.

Everyone's life has been drastically altered by the present pandemic outbreak, which has also led to economic problems and travel restrictions in the majority of countries (Selvaranjan et al., 2021). Due to a variety of illnesses that contributed to these epidemics, poor living circumstances have also been a result. Simple tactics like physical segregation and isolation are no longer effective in containing this persistent problem. This raises questions about the efficacy of the methods now being used to stop the spread of the pandemic virus. To combat the pandemic virus and its offspring, hospital interior design process must adopt a more modern, all-encompassing, and creative approach (El-Sayed et al., 2021). There is proof that the pandemic infection and air quality are tightly associated, and that airborne transmission might happen (Awada et al., 2021). The pandemic pathogens are tiny aerosols with a diameter of less than 5mm (Fennelly, 2020; Albuquerque et al., 2012). Since the ultrafine virus particles in the liquid are light, they normally last for around 30 minutes as an aerosol in the environment. According to recent investigations, indoor aerosol transmission of pandemic is a major source of infection, particularly in crowded and poorly ventilated environments (Megahed & Ghoneim, 2021). It is crucial to maintain the interior air quality as high as possible in order to stop the spread. This necessitates innovative improvements to the existing indoor and outdoor infrastructure in order to benefit the locals in even the most densely inhabited places (Tokazhanov et al., 2020). Additionally, this makes the strategy for creating and building hospitals in the wake of the pandemic more difficult (Kaklauskas et al., 2021). The post pandemic architecture is suitable for usage in both existing and future hospital buildings with healthy building components. The interior design of a cozy and attractive hospital process is the primary goal of the healthy building idea (Ujanová et al., 2019). In most highly crowded hospital facilities, a healthy indoor atmosphere is anticipated to help patients in terms of their physical, emotional, and social well-being (Al horr et al., 2016). The level of the living environment that exists inside a building is referred to as "interior environmental quality" (Lai et al., 2009). Temperature, visual, auditory, and chemical elements are only a few of the variables that have an impact on the quality of the indoor environment (Lewtas, 2007). Indoor air quality, thermal comfort, ventilation, acoustic performance, lighting, and spatial layout are some of the criteria that should be evaluated alone and/or

in combination. Due to the likelihood that these elements will change as a result of the building's use, buildings that have just been built or are already in use might not have the ideal quantities of these components (Larsen et al., 2020). The pandemic outbreak, which is widespread in most hospitals in the Jordanian region, is one of the largest challenges (Navaratnam et al., 2022). The pandemic has an impact on how hospitals are built, how technology is developed, and how information systems are used (Verheyen, J., 2011). Researchers and practitioners in the field of information systems and technology can aid in the analysis of the pandemic by choosing the optimal building design process to impede and stop the virus' transmission (He et al., 2021; Li, Y., & Xia, L., 2020).

There are no guidelines for the pandemic hospital interior design process in Jordan during the pandemic, though, many scholars attempted to research interior residential building designs during the pandemic (Shamaileh, 2022). According to a study, there are both present-day and foreseeable solutions that could be used to deal with the pandemic's effects on the interior architects of building design. A conceptual model was also suggested. This is all the more reason why a quality and effective structural design process is imperative as an essential component of healthcare institutions that will be a valuable safeguard in important times.

Statement of the Problem

The pandemic breakout which the world is currently dealing with took its first state of emergence in Wuhan and to contain the pandemic became a real struggle, soon after which its first state was recorded in December 2019, and as of January 2020, China has already implemented the control of its law that accounts for how diseases are managed in terms of control and prevention to ensure that the government agency tasked with the management of disease outbreak (National Health Commission) tackle this problem as a priority infection class B infection and subsequently put in place management practices to curb its spread.

However, due to the fact that the most viable method of transmission of the disease is through the respiratory tract, it became apparent that the best way to manage the disease is by implementing said class as an infectious disease.

The nature of the infection in question has necessitated the need to approach the infected in a carefully controlled manner. A class a control measure for infectious disease prevention including quarantine services for people just venturing into another environment and may have to do with the placing of such people together with people with confirmed or suspected cases of the virus in isolation where they are subjected to close monitoring.

Nations all over the world took different measures in getting the better of the deadly virus. Wuhan, which is the country in which the deadly virus originated from responded to the state of emergency by taking important health initiatives such as developing what is called a module hospital" for treating people with confirmed cases. Even though the set of hospitals used during natural disasters and wartime serve almost the same purpose as their interior architectural design process differs. The module hospital is a large spaced multi-bed health facility that serves a temporary but rapid essential purpose in dealing with the severe breakout of the disease. The importance of this module hospital cannot be overstated in that it allows a high number of patients with confirmed mild illnesses to have access to effective medical treatment in a timely.

Meanwhile in Jordan, on the 16th of March, 5,800 people who were just gaining entrance into the nation were subjected to 14 days of compulsory quarantine in hotels across Jordan to curb the continuous outbreak of the pandemic in the country. There were a total of 1,696,937 infectious cases of pandemic in Jordan and the keep increasing with 269 positive cases on a weekly basis with a total of 14,066 deaths (Ministry-of-Health-Jordan, 2022). These figures show that there is urgent need for this research find the appropriate quarantine centres for these pandemic patients to be treated and closely examined.

According to the Ministry of Health spokesman Natheer Obeidat, in this regard, a lot of people in Jordan are being afforded accommodation in different hotels, numbering up to 34 at various locations throughout the country. It was confirmed that altogether, 3,104 Jordanians and non-Jordanians were sheltered in 23, 4 and 5-star hotels in the city of Amman, 1,923 in 10 Dead Sea Resorts and 23 across lodges in Aqaba with each placed under beautiful all-round security restrictions. The minister pointed to the fact

that this mode of approach toward the deadly disease is of high financial benefit as opposed to when the patients are to be treated.

When module hospitals are in place, mild cases of the pandemic illnesses are well managed and tended to in timely manner to prevent such cases from spiralling out of control. Just like in any case of pandemic diseases that grows into a huge situation, when they are tackled at the early brewing stage, with adequate preventive and control measures implemented, a better grip is obtained on the outcome of such disease. On the other hand, if conventional hospitals and healthcare centres are left to the handling of such a novel and deadly virus, they encounter challenges most prominent of which is shortage of beds. Just like a typical stationary hospital, a module hospital can accommodate the specialty wards and sections which make a health facility tick including a medical function unit, a ward unit, a technical support unit, and other parts, providing multiple functions such as emergency treatment, surgical treatment, clinical examination, and others.

The problem lies in the fact that the mode of approach which is employed by Jordan may serve as an essential purpose of quarantine well, but it does not provide a lasting solution to the problem in case of any other unforeseen outbreak of other diseases. The findings of this doctoral thesis will seek to provide an easily adaptable model which will require little time and resources in its establishment with its purpose not being defeated.

Purpose of the Study

The essence of this study is to qualify the abstract and genuine take of people about the state of major healthcare centres in Jordan and possibly propose new process designs of health facilities that can further strengthen the hold of the nation and put it in better stead when it comes to handling future cases of a pandemic outbreak with much emphases on current pandemic outbreak.

The study also intends to provide 3D proposed module design standard procedure that will be up to the standard which is recommended by leading health organizations around the world.

The specific objectives of this study are;

- To expatiate on ways to go about interior design and implementing medical dispensations in a typical interior hospital process in the management of pandemic.
- To examine the level of preparedness of healthcare facilities and medical centres in tackling epidemic cases, focussing on interior.
- Establish a template/blueprint which can be put into use now and in the future, within and beyond the walls of the nation in tackling similar cases to pandemic sustainably.
- Develop or reinforce guidelines for entering or having access to such health facilities where cases of pandemic are managed.
- Equipping healthcare centres, both existing and model ones with a process one will base all the necessary facilities needed to aid its proper functioning.

Research Question/ Hypotheses

Below are some of the pertinent questions which the study looks to answer;

- Are there essential pandemic functional and technical areas including rooms, wards, and units, or better still, are there any specialized pandemic management hospitals?
- If available, are there hospitals that treat pandemic and are capable of sustainably handling related cases that may require any ventilation?
- Are there established pandemic surge plans in hospitals, healthcare centres, and isolation centres?
- Are there any plans in place in different settlements in close proximity with such disease breakout, in this case, pandemic to successfully manage and control the impending epidemic?
- Are quarantine units well placed to estimate pandemic let-off standards and dispositions when the recovery is over?
- Are the hospitals and quarantine centres having the capacity required to accommodate the number of patients in terms of number of beds, health staffs, and medical tools and supplies?

This research provides a theoretical summary of the pandemic matters related with technological advancements through evaluating and formulating numerous hypotheses of clinical research as a physical management of the current and future pandemic cases. The research beginning through a draft of the modelling of structural hypothesis method to study proposals, data collection, analysis and considering a sequence of clinical investigation hypothesis within physical equation modelling. Lastly, concluded with a unit of deducing a causal physical research hypothesis model.

Here the research adopts complex hypothesis due to the existence of multiple variables in this topic. The hypothesis tries to relate the relatıonship between hospital design processes to the technological advancement towards the management of pandemic cases. Here the independent variables are hospital design process which heavily depends on the outcome of the independent variables. The dependent variables were management of pandemic cases and technological advancement. The null hypothesis (H^o) and alternate hypothesis (H^1) are present below:

H^0 = There is no relationship between pandemic hospital process with the new technological advancement and management of pandemic cases.

H^1 is the opposite of H^o, which says that there is relationship between pandemic hospital processes with the new technological advancement and management of pandemic cases.

The result of these hypotheses will be collected, analysed and presented in this thesis.

Significance of the Study

This research work is to be implemented to establish a befitting bridge between conventional hospital structures and the desperate need of medical attention for the management of unforeseen pandemic cases like the on-going war against the Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2). This thesis provides a creative interior architectural process that can be implemented in existing hospitals as well as new ones and will ensure that such nations like Jordan is well equipped to combat, also intends to provide standard procedures that will be up to the standard that is recommended by leading health organizations around the world.

Limitations

Limitations areas are noted that are most possibly going to pose challenges to the smooth completion of this study and they revolve around data collection and analysis.

Participants will be required to answer some specific questions that may not encompass the pertinent issues that are embedded in the need to construct tailor-made healthcare centres and hospitals, which may only be well addressed by building contractors. The rationale behind this research work is meant to be descriptive and the possibility of hypothesis testing is allowed.

For the case studies, four hospitals were selected to act as case studies. 1 of these hospitals was selected from Irbid which is the second-largest city in the country of Jordan and 1 from Amman, the capital city; while 2 of the hospitals that were selected from Zarga and Ma'an, as well as the different components of the hospital building including the ward or sectional forms.

With the design and representation of hospitals obtained from underdeveloped nations of the world may be poor. The comprehensiveness of the study is challenged by the fact that a general statement cannot be made on the scope of coverage of the study around the world is limited. Recommendations will however only be made for the nation with little usage or reference to other nations.

The limiting factor is the availability of adequate information on the first-class advanced stops in medical facilities. An upgrade is being witnessed in the area of plans and architectural designs and it has also seeped into the healthcare sector as well. Novelistic approaches have been arrived at and there are reasons to believe that the introduction of new ideologies is not bound to end now. It is therefore a challenge to arrive at plans and designs for module hospitals that will not stand the test of time.

In terms of collecting and analysing the data, qualitative and quantitative research methods, which are called mixed methods, have been adopted for the present study.

The project is a proposed cross-sectional, internet survey-based research which is to be administered to health practitioners in Jordan. A total of 382 questionnaires (22-items) was prepared and administered in the soft and hard copies.

The study will be conducted in Jordan. The study will conduct semi-structured interviews with administrative members of privately-owned hospitals, clinical staff, doctors, nurses, and other healthcare workers. The main purpose of the interviews is to retrieve first-hand information on how the building structures and health facilities that are used in housing pandemic patients have served the purpose for which they were built in curtailing, limiting, and generally managing the spread of the disease. Moreover, to explore the way of thinking, assumptions, emotions, attitudes, perceptions, this might be influencing the choice of stakeholders and decision-makers, and among the other purposes. In addition, interviews enable researchers to ask more detailed questions. Also, ambiguities can easily be clarified and incomplete answers followed up.

Participants will be recruited from selected hospitals and specialized healthcare centres that are dedicated towards the fight against pandemic and online from social media and applications (Twitter, Instagram, Facebook, LinkedIn, and WhatsApp).

The questionnaire will be conducted in 60 days. The survey will be delivered in English and Arabic to widen the scope of coverage to unlearned individuals that have had an encounter with the victims of the pandemic.

Participants will be able given the chance to complete the survey at a single sitting and they will also be able to discontinue to terminate their involvement in the survey as they deem fit. Results obtained from the survey will be anonymously recorded and kept in secrecy.

Few introductory lines will be presented at the beginning of the survey providing further clarity as to why the study is taking place.

The standard of many hospitals around the world is well the standard which is required to be able to successfully manage cases of pandemic in terms of healthcare workers (human resources) and diagnostics requirements. The questionnaires was be designed to address the problem statement and to achieve the target of the research work. The thesis included with the demographic information of the participants.

Also, the study will conduct secondary research to collect information from journal articles, books, and other existing literature on the proposed topic for a definite understanding.

Definition of Terms

Management process: depends on disease severity and focuses on the following principles: infection prevention and control measures; symptom management; prevention of disease progression; optimized supportive care; and support in severe or critical illness.

A pandemic: is the worldwide spread of a new disease. Viral respiratory diseases, such as those caused by a new influenza virus or the pandemic, are the most likely to turn into a pandemic.

Coronavirus disease (COVID-19): is an infectious disease caused by the SARS-CoV-2 virus. Most people infected with the virus will experience mild to moderate respiratory illness and recover without requiring special treatment.

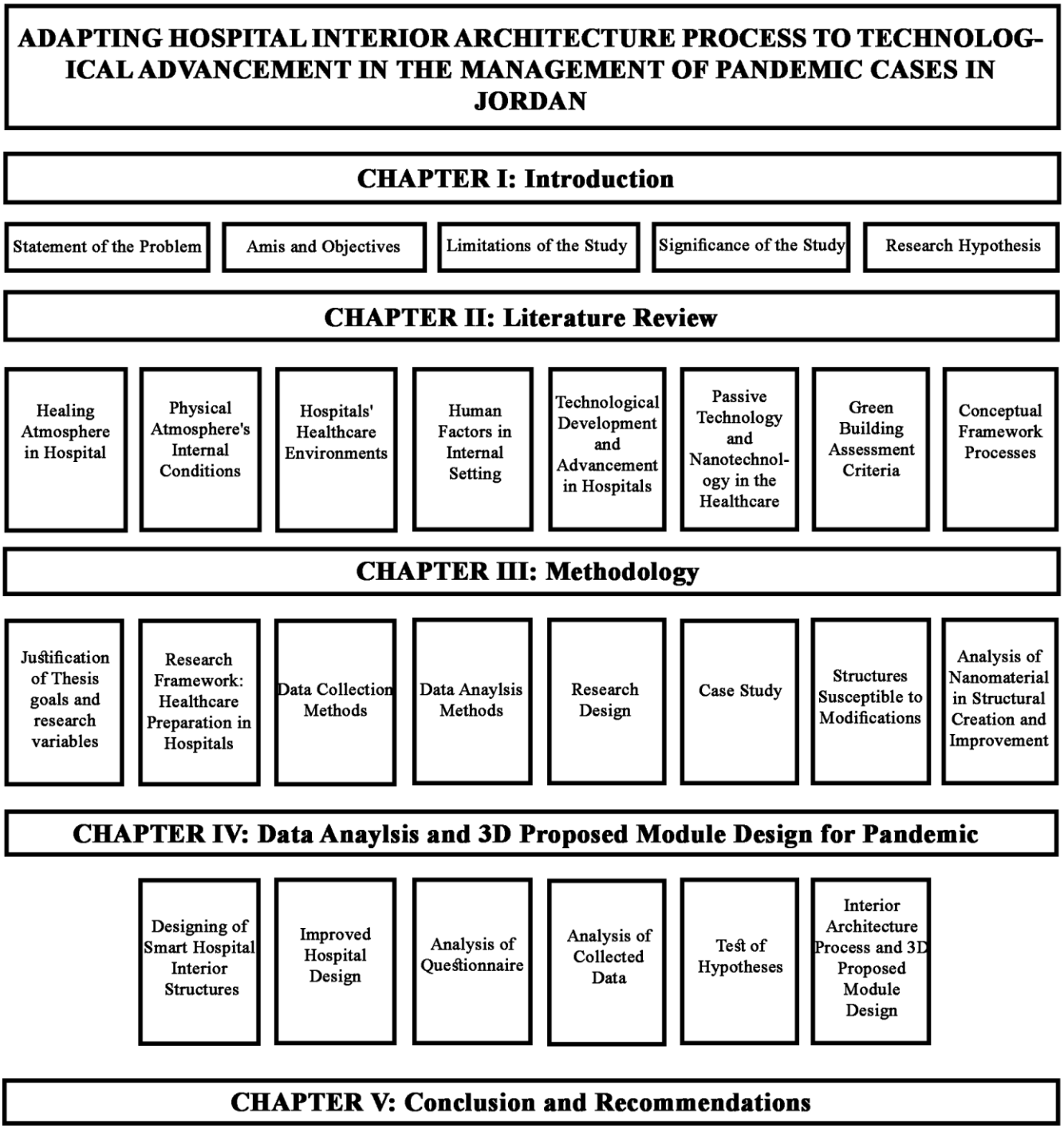
Hospital design: refers to the process of planning, designing, and constructing healthcare facilities. This complex process involves a multidisciplinary approach that balances architectural aesthetics, functional efficiency, medical technology integration, and patient-centric care principles.

Design strategy: is a systematic and intentional approach to creating solutions that meet specific objectives. It involves analyzing the goals of a project or organization, understanding the needs of stakeholders and developing a plan to create solutions that are effective, efficient and sustainable.

Design flexibility: can allow a building to evolve over time as the user needs change. The flexibility of a building or elements of its design can allow it to be used efficiently despite changes in operational requirements, whereas an inflexible building might become obsolete.

Figure 1

Thesis Structure



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CHAPTER II
Literature Review

Theoretical Framework

Introduction to Healthcare Design

In recent years, designers, architects, aid providers, and researchers have become increasingly concerned about hospital design and healing processes (Devlin and Arneill, 2003). According to a comprehensive review of aid style, aid providers have progressed to the point where they have no choice but to develop aid settings (Marmion, P., 2012).

According to Krokfors, K. (2017), flexibility is the ability to establish units of functionality within an existing building that were not originally conceived during the design stage of such buildings. The new set of functionalities that can be achieved is a hugely valuable asset that building owners can capitalize on to avoid the need to demolish buildings prematurely and thus save valuable resources. A flexible design is also one that allows different activities to be completed within a specific space without physically rearranging the existing setting. It allows for the physical reorganization of a building's units, including its elements, services, and furniture (Gössel & Leuthäuser, 2001).

Patients expect help with all aspects of hospital healthcare, not just the physical care unit, consultation, medication, and physiatrist. Affecting and the quality of interior architecture in staff spaces are secondary to architectural planning, and evidence-based design is a meticulous methodology in the decisions that have to do with carefully considering previous work and findings to the implementation of some models of the design of every specialized project (Alhmoud, Çağnan, & Arcan, 2020; Cetin et al., 2018). All of this can be improved if the hospital environment is designed with the patient's preferences in mind.

Another point to consider is how the above-listed definitions can be transferred into a set of layouts/blueprints for flexible hospital design. Modern hospital designs, especially those that are erected in the 20th century have cued in towards the point of flexibility. According to Devlin and Arneill, (2003), physical style alterations that make

the space increasingly pleasant and more beautiful reduce stress in the users and maximize comfort ability through hospital rooms (Yamaguchi, 2015).

According to research, (natural and artificial) is also thought to improve health outcomes. "Analysis displays which make patients hospital in well-lit space stay for a shorter period of the room than one in an uninteresting space," (Jamshidi & Hashemi, 2020).

Healing Atmosphere in Hospital

The term "healing environment" refers to the atmosphere that is expected in design facilities such as hospitals. Not all healthcare facilities have hospital spaces that promote healing and send out calmness (Seyedahmadi, 2019). From a research perspective, a healing environment may be considered a novel concept. However, when it comes to the study of the effect, this idea has not changed. Both Perumal et al., (2021) and Ulrich (2004) investigated the effects of windows on hospital patients' well-being. Farley and Veitch (2001) discovered that being close to a window and thinking about the context outside the opening improved a patient's well-being (Morano et al., 2020).

Table 1

Indeterminate Interior Architecture: Aalto, Le Corbusier and Weeks'

Indeterminate Interior Architecture: Weeks' four principles
▪ The most essential services and interactions units are sited away from the structures they meant to serve.
▪ The functionality of an entire interior space building or part of it can be adjusted without disrupting the existence of others.
▪ The design which is implemented in a building will allow for function served by different part of such building to be changed or altered at will.
▪ Any form of plan to expand the functionality of the building will be in relation to the orientation albeit not inline precision. The interaction lines however are expressed in orientation and forms. Even the interior space building must be taken into concern.

(S.H. Alhmoud-2022)

Unfortunately, this is not the case in care facilities, where people cannot simply leave if they need medical care. Patients have to adapt to such situations, which undesirably affects their recovery. According to the literature, some areas of care do not appear to be designed in a way to provide healing environments.

Setting dimensions in hospital

Han et al., (2019) classified physical dimensions into three categories: close conditions, interior conditions, and design. This study examines people's perspectives on healthcare facility spaces in the context of inner design to help the design expert better understand. The standards in regulations do not precisely define healthcare staff spaces. Furthermore, design decisions affecting the quality of the interior in staff spaces (visual, audial, thermal, and ergonomic, etc.) are secondary to architectural planning. The design condition of healthcare refers to its design features. These are fixed components that cannot be changed or examined.

The room designer should consider the elements that contribute to the creation of a positive atmosphere. The purpose of this study is to provide recommendations for hospital-based infectious disease prevention care analysis.

The physical setting & human behaviour in Pandemic cases

a. The physical setting in interior & exterior

According to Alvarez (2004), there is one universal truth about hospitals that don't appear to be well-designed for patients to heal. The furniture is hard-edged and bland, the lighting is artificial and harsh, and the environment is unappealing (Leibrock & Harris, 2011) and the concept of increasing the design well in circulation to improve healing and health.

The significance of physical environmental style characteristics influencing and affecting our lives has been acknowledged. Alvarez proposed that all public buildings health take the following factors into account:

- Durability should be assured once foundations are carried to the land and materials are wisely and generously chosen.
- Convenience is achieved when the composition of the Healthcare is flawless, and this can be accomplished without causing any inconvenience to the patient.
- According to the citation, "beauty is significant, in such a way that the look of the work is agreeable, and in a smart state" (Fottler et al., 2000).

According to Han et al., (2019) theoretical framework, interior components influence user behaviour to people could respond to their physical surroundings in one

of two ways: they could be satisfied or they could turn away (Binter, 1992). Approach behaviour is characterized by a positive reaction to the environment. Safety and security are of the highest importance. Patient exposure, and disability, must be minimized by selecting appropriate finishes, materials, and devices to ensure the security of patients and their personal belongings and describe the inside dimensions that influence user behaviour.

According to Fottler et al. (2000), the setting of the patient room is an important part of the healing expertise. The hospital setting and organization should be closely monitored to ensure caretaker and carer satisfaction. The layout of the area, the colours on the walls, and the settings can all contribute to a patient's sense of well-being and safety (Han et al., 2019).

In the study, users can fully respond to the wall colour, artwork, and lighting, ensuring happiness in a typically organized setting of single room occupancy. However, alternate solutions include turning away behaviour, which is aided by the patient's willingness to avoid remaining in the patient's room. If the user is dissatisfied with the quality of the environment, the user may avoid hospitalization.

b. Human behaviour inside the atmosphere

Insights into the physical environment elicit unique closure, mind-set, and deep thought solutions, which influence the three (3) behavioural tips (Leibrock & Harris, 2011). Internal responses are classified into three types: physiological, cognitive, and emotional (Jantunen et al., 1998).

According to Binter (1992), positive responses may result in approach behaviour (satisfaction), whereas negative responses may result in place shunning. For example, if a patient goes to the hospital for treatment and is unable to sleep due to an uncomfortable bed or inappropriate room furniture, the user may experience a negative emotional response. Single inner responses (emotional design, cognitive care, and physiological healthcare) to patient room behaviour influence user-shunning behaviour. Hospital design professionals are frequently confronted with a significant challenge when it comes to creating healthcare facilities that improve user satisfaction.

Environmental psychological science research strongly suggests that physical environmental factors influence behaviour in a variety of ways; thus, determining the most fascinating setting is the first step in designing healthcare with a functional (hospital room). Another strategy is to find a setting that encourages individual approach behaviour and satisfaction (Han et al., 2019).

Positive (negative) inside responses result in approach (avoidance) behaviours by (Han et al., 2019). Avoidance can have the opposite effect, such as the need to leave a hospital room.

When designing a room, for example, the first step is to determine both the room's and the hospital's goals. Hospitals strive to please their patient and improve the well-being of their patients throughout their stay. Because patient behaviour is linked to wellness, a design expert would be better off recommending which model may aid healing and support the hospital's goals (Huisman et al., 2012).

c. Interior indoor air quality of hospitals

To ensure the health and wellbeing of its occupants, a building's indoor environmental quality must be optimized. (Šujanová, Rychtáriková, Sotto Mayor, & Hyder, 2019). The quality of the air is one of the main factors in establishing a healthy interior atmosphere. (Kapoor et al., 2021). The quality of indoor air can be harmed by pollutants from both external and internal sources, including those brought on by people, animals, machinery, and building materials. (Smieowska, M. et al., 2017). Organic gases like volatile organic compounds and inorganic gases like radon and ozone can contaminate indoor air (Tran et al., 2020). Additionally, airborne particles including mold, asbestos, and silica dust can contaminate indoor environments. (Schulze, F. et al., 2017). Poor indoor air quality brought on by these indoor air contaminants leads to health problems like asthma, sore throats, shortness of breath, and heart conditions. (Shen, J. et al., 2021). Along with bronchitis, major illnesses like cancer and chronic lung conditions are also made worse by poor indoor air quality. (Shrubsole, C. et al., 2019). Additionally, these indoor air pollutants are frequently connected to mental health issues like elevated anxiety, increased violent behaviour, deteriorated focus, and mental fatigue. (Sass, V. et al., 2017). In order to maximize indoor air quality, the spatial

organization should be considered when constructing a structure. A conceptual design strategy called spatial design takes into accounts both interior design and service design. People must move between internal and outside locations in order to accomplish this. (Akadiri, P.O. et al., 2012). Designers frequently make choices that encourage social connections based on the sociability and wellbeing of the inhabitants. (Wineman, J. et al., 2014). Additionally, using indoor plants, fresh air, and natural sounds, biophilic design principles are applied to enhance the quality of indoor air. To facilitate a patient's quick recovery and shorter hospital stay, indoor plants and natural sounds are strongly advocated for hospital designs. (Chatzikonstantinou, I. & Bengisu, E., 2016). Since many infectious diseases are brought on by viral types that are comparable to the pandemic virus, it can also be anticipated that maintaining higher indoor environmental quality can also be effective against them. (Al horr, Y., et al., 2016; Lai, A.C.K. et al., 2009). Creative approaches and more durable solutions are needed to reopen a nation since transient conditions like remote jobs and restricted access cannot be maintained (Han, H., 2019).

The Physical Atmosphere's Internal Conditions

Aesthetics in healthcare facilities

According to a research scientist, the aesthetics of attention environments are necessary for patients' feelings of well-being (Dijkatra, 2008). The assertion is that generating visually beautiful environments will aid healing and improve patient well-being.

Perception & aesthetics

Individual differences should be considered by the designer by a variety of environment occupants about their likes and dislikes at various points in their environment. An inner designer who is aware of the concepts of perception and aesthetics can assist in connecting vision to the patient room. Light, colour, design, and furnishing are the primary dimensions of environmental aesthetics. These four aesthetic elements are well-known among patients, and they must also be able to convey comfort and care (Sein, M. K., 2020).

Interior designers must understand the fundamentals of beauty and aesthetic appeal. Aesthetic values can be understood on a global scale (Suresh & Smith, 2007). These architectural concepts are linked to a specific technique of connecting with the human senses and extend beyond the practicality of the space (Cooper & Lipsitch, 2004). When the occupants look at the inside objects, the appearance of the environment creates a subjective perception that influences their behaviour.

According to Mazuch (2017), the health benefits of sunlight cannot be overstated, hospitals used to have large windows that allowed natural sunlight to flood the space. Beds were pushed out onto balconies and terraces. The effective use of sunlight is an important aspect of healthcare facility modelling. The light should also be used creatively to illuminate and create a sense of occurrence and wonder for the interior and exterior of structures (TanjaDijkstra, K., & Pieterse, M. E. 2011).

Hence, as much natural light as possible should be accessible in healthcare facility rooms and employee areas throughout the building. Natural light-weight is a vital component in facilitating healing, according to studies (Carpman & Grant, 2). To create a high-quality healing environment, both natural and artificial light should be used. The design of the colour surroundings is affected by the weight of the healing environment. Every effort is made inside the hospital to lighten the inner to the optimum level and at the same time regulating appropriate light and temperature circumstances for the patients. Because light changes the appearance of hospital rooms, it also has aesthetic effects. The occupants' sense of well-being is positively influenced by the visual environment, which may have an impact on employee performance and patient recovery in hospitals and care facilities (Salonen et al., 2017). Artificial lighting layouts have to be planned to evade the creation of lighting effects in the first place, but not exclusively.

Individual Emotional Responses in Healthcare

Hospital art dates back to the 1980s in Europe, when hospitals began to decorate their walls with art as if they were a gallery. Designers should indicate art that captures a patient's current state of health because it develops the standard of a hospital-room. This study is almost certain to uncover preferences for public art that could be implemented in single-occupancy hospital rooms.

According to Mazuch (2017), internal responses can emotional responses that influence a person's behaviour. It would imply that patient preferences are influenced by emotional factors related to the hospital rather than direct personal preference. Professionals in hospital design and ornamentation, like all other health-care providers, must create environments that promote patient healing and satisfaction.

Changes in Care Atmosphere

Colour development has interest throughout the twentieth century, and the use of colour for healthcare, design, and industrial purposes is gaining traction. Colour is becoming more popular as cultures diversify, and its applications are expanding. In the twentieth century, hospitals created a boring, monotonous white environment. On the inside, the walls, ceilings, furniture, and linens were all white.

Hospital inexperience was the dominant colour in the care environment. As the rooms transitioned from the highest ground with skylights and artificial lighting to the inner rooms with only artificial lighting, green was used in the operation rooms and in support of colour as a healing tool. According to Kenneth Edwards (1979), people who are change in their traditional lives are even more vulnerable to the influence of colour when they aren't feeling their best. As a result, a colour scheme appropriate for a patient's recovery may be advantageous (Uwajeh & Polay, 2019). The hospitals inexperienced were advised to serve in order to reduce the aftereffects on in-operation personnel (Schweitzer & Frampton, 2004; Harte et al., 2017).

Interior designers are now using different colours in the finishes of hospital environments. Colour research concludes that colour has a significant aesthetic role to play in the style of our surroundings (Uwajeh & Polay, 2019).

- Patients on their manner to restoration and maternity patients who require physical description can benefit from the sun's colours.
- Wherever patients anticipate examinations or tests, emergency rooms should be decorated in cool colours with low lighting.
- Receptions for anxious family members and friends to wait would benefit from calming colours.

- Colours that contain yellow-greens is advised to not be involved due to their ability to reflect bouncing images or light and as a result makes the skin appear in a way that negates good health with an unflattering purple aftertaste (Uwajeh & Polay, 2019).

People's reactions to different colours are caused by differences in how they perceive colour. According to Iyendo and Alibaba (2014), the brain converts the signals into colour. Because it is such a simple way to change the atmosphere of a room, quality is an important factor in interior architecture. Patients may respond better in a more relaxed environment (i.e., a healing environment).

Colour is frequently used in the designed environment to create optical illusions as well as to provide an aesthetic feeling. The use of bright colours draws the viewer's attention to the item. Heat tones are frequently used to lower high ceilings because whites and yellows show through before other colours. Long corridors are frequently cut to draw attention to the end with warm colours. Cool colours make rooms appear larger (Dalke & Matheson, 2007).

This viewpoint is shared by Jonas and Chez (2004), through oral communication Colour enhances light by brightening or dimming areas, providing sensory stimulation, providing directional and alternative information, and optically changing the proportions of an area. Colour and light in healthcare facilities must consider more than just subject matter or aesthetic criteria; they must also consider specific user needs (Stidsen & Fisker, 2009).

Despite the fact that wall colour is environmental information that can be easily changed and the literature reviewed cites empirical evidence, there is a lack of focus on environmental coloration in healthcare care settings, and thus change the atmosphere of an environment. Recognizing a stumbling block and implementing a change-designed care environment is a critical step in the process. The next step is to rethink how we typically use colour to create healing care environments. Colour perception and individual psychological feature responses are then discussed.

Individual psychological feature response in hospital

The cognitive response is defined as an individual's assumption of such place settings based on prior perceptions and signs of communication by physiological hints in the environment, as well as the respondent's link to previous wellness or rather a way of life influencing their choices. If a patient has been cured quickly in the past while in a blue-painted room with a painting on the wall, that patient may subconsciously associate previous occurrences in such a scenario with wellness and thus imply it.

Ventilation in Healing Process

A window is one of the necessary interior parts in a single occupancy. It is thought to be necessary for space users. According to Shumaker and Pequegnat (1989), patients prefer rooms with windows as long as the views are interesting, ideally a view of nature. A joint laboratory study discovered that natural sights result in advanced levels of relaxation. Accordinsg to Urlich (2003), hospital healthcare with a view of nature can reduce wellness time and increase adequate rest. The researchers concluded that window views help occupants develop a "perceptual and psychological feature link with the external atmosphere," which can have a significant impact on the therapeutic method and improve the healing environment.

Table 2

Design Features for Enhancing Natural Ventilation

DESIGN	DESCRIPTION
Building Layout	**For air-conditioned buildings**
	Building compactness to better manage space.
	Windows should be smaller to reduce heat transfer through and out.
	For naturally ventilated buildings
	Buildings should be spaced out in well-chosen locations rather than being excessively crowded together in one area.
	A large garden should be available, and windows should be large enough to allow for appropriate cross ventilation, improving sleep patterns.
	Building is important to take wind direction into account to prevent obstructing air flow and provide enough cross ventilation.
Plan for Major Rooms, Doors and Windows	- The layout should consider where to place offices, wards, and rooms for proper ventilation. - Avoid letting the sun's rays touch the east and west edges of the walls. - The windows should be oriented such that proper airflow and air exhaustion are not impeded, and sunlight should be allowed to enter and exit without obstruction. It is recommended to place the windows at angles parallel to walls that are not immediately across from the ones to the east.

Relationship of the Building to the Ground	The presence of tall vegetative cover will only help air movement and circulation. Buildings that are raised to a few levels above the ground rather than disconnect on the horizontal will allow more access for more ventilation to reach the building.
Operations and Management of Interiors	In the daytime, efforts should be taken to lessen the amount of heat entering hospital structures. This can be achieved by closing the windows and doors, and lowering or covering the curtains. Specifically, this applies to windows that are located on the same side as the dawn and sunset.
Vegetative Materials in Proximity to the Building	To better battle the effects of urban heat, it is advisable to use any type of vegetative cover that is present inside or around the hospital building, including rooftop gardens, taller plants, and vegetation on the ground in hospital areas. A smaller number of surfaces are also exposed to direct sunlight, which reduces the need for cooling systems and saves energy.
Thermal and Structural Properties of Walls and Roof	- The best materials to choose should be ones that can boost cooling at midnight while decreasing heat at noon. Therefore, it is important to make sure there is enough ventilation to prevent the development of stale air. - To keep the majority of the sun's rays from passing through the roof, a type of heat radiation element made typically of aluminium can be added. - High-quality roofing materials can contain water for cooling, absorb less heat, and lessen the amount of heat that is felt indoors. in a situation where there is space above the decking for some minor crop growing. The addition of thermal and acoustical insulation will safeguard the roof underlay and lengthen its life.

(Birkeland, 2012)

According to Garbey et al., (2015) nature scenes have a more positive effect and reduce stress more effectively than city sightings. The window allows natural light into the room, which helps to reduce disease. Urlich (2004) conducted a survey to compare workplace employees' preferences for daylight and a lamp and discovered that employees preferred daylight over a lamp.

Importance of Single Occupancy and Human Behaviour in Hospital Room

The perception of the environment is hampered by social science desires, circumstances, and individual differences (Edward, 1990). Human behaviour is affected and influenced by the single occupancy interior. Activity responses to the environment are influenced by the state of each mental and physical stimulus.

Individuals' perceptions of their environment have an impact on their social interactions in that environment. Single occupancy rooms in a hospital can improve privacy. Hence, in hospital twin rooms, privacy can be achieved by placing a shade between the beds, shielding people from unwanted physical and visual contact. Individual social interactions are frequently described in terms of three basic perceptions: personal privacy, individual interface, and behaviour.

The health-care service provider should establish in addition promote single-occupancy rooms in hospitals, which will improve single privacy heights in hospital rooms. (Day et al., 2020), Interior architects must recognize those classes when designing hospital rooms, and apply the applied science rules to room design.

In planning hospital rooms, interior architects have solely their read for spotting flaws, with no fixed resolution. An example, some construction activity can surface to resolve the issue, and if you have a legal issue, a professional can act within a framework. Environmental designer investigates the issue without regard for resolution, hospitable diversity, consumer or style quality, and proposals for the possibility of interdisciplinary outcomes (Day et al., 2020). In light of this, this study used consultation and co-present collaboration techniques, as well as thematic analysis processes, to establish an exploration technique and style tool.

This method enabled the inside stylist to develop a knowledge base and strategy awareness that will change the way healthcare professionals and specialists approach design issues in hospital rooms (Ho, A. G. 2018).

Table 3

Conditions for Ventilation in Different Areas of a Hospital

Area	Pressure in relation to other areas'	Minimum total no. of air changes	Recirculated within room
Operating theatre	+	12	No
Emergency operating room	+	12	No
Delivery room	+	12	No
Nursery	+	12	No
Recovery room	0	6	No
Intensive care	+	6	No
Ward room	0	2	Optional
Patient area corridor	0	4	Optional
Isolation room	0	6	No
Treatment room	0	6	No
X-ray (fluoroscopy) room	-	6	No
X-ray (treatment) room	0	6	Optional
Physical therapy room	-	6	Optional
Sterilizing room	-	10	No
Laboratory, general	-	6	Optional
Laboratory, media transfer	+	4	No
Anaesthesia storage room	0	8	No

(Levin & Joseph, 2009*)*

Hence, existing strategies should be modified to identify users' needs, and to develop and improve the method for analysing data collected from users.

Hospitals' Healthcare Environments

To form healthcare environments, designers rely solely on their expertise, according to a simple examination of single occupancy rooms. Hospital stylists must be compelled to focus on making each design call profit the user to change the building's success. They have research-based responses to the healthcare setting style question, “What are the most popular interior architects and ornament options among the final public in hospitals with single-occupancy rooms"?

The most popular style and décor are identified in this study, which can assist interior architects in rethinking the look of healthcare facilities. A lot of designers aren't aware of how important it is to create healing environments. When it comes to creating wellness environments, design experts have limited options for analysis.

Rengel (2003) writes that engineers are faced with a major obstacle in the creation of a good healthcare interior environment when it comes to these approaches to healthcare. Users entering a hospital are already disturbed, so it is important that the appearance has a completely pleasant effect on their condition and contributes to their satisfaction, or at least does not aggravate their disease.

Hospital interior architecture issues & practicality in style

Designing an interior space can be a difficult task. Rengel (2003), talks about the personality of inner design. “Designing smart interior areas is difficult,” he says. The quantity and quality of style issues are mind-boggling. Further, many designers miss the importance of planning therapeutic environments. Hence, designers have very little guidance, and acoustic analysis is supported, to use in making therapeutic environments.

Ho, A. G. (2018) supports this audio-reading connection, with many inner designers designing hospital-facilities with a nearly total mental object of character that the engineering setting shows in patient health-outcomes. However, designers produce areas that exploit their presented tools, intuition, and personal preferences. Also, engineers face a major challenge in planning a positive hospital inner setting when it comes to these approaches to healthcare. Patients arrive at the hospital already upset, so

it is very important that the appearance has a positive effect on their condition and helps in their wellness, or at minimum prevents against the aggravation of their disease.

The inner setting of a hospital facility is critical to its users. Hospital room interior designers must consider many factors, including physiological responses, practicality, and applied science, during the research design (Powell & Weinberg, 2002). These are throughout the interior design and these desires are related to the physical requirements of the occupied space. Indoor environments must satisfy all a person's needs for good life (Suresh & Smith, 2007). The level of comfort is determined by the type of furniture design, equipment, finishes used, and patient satisfaction with the interior space design.

In hospital rooms, the wall colour can have a significant impact on user satisfaction. According to Suresh & Smith (2007), all physiological desires have an impact on how a person perceives and responds to internal space. Once the person's desires are adequately, the room user can consider the setting safe and satisfactory.

Applied Science in Style

Ergonomics recognizes that interior design has a significant impact on a person's behaviour (Suresh & Smith, 2007). The challenge is to create a space that is suitable for the occupier's activities, furnishings, and finishes. Anthropometrics, for example, is used in applied science to determine the size of a user's bed. Every aspect of room style that has been used to furnish the space must be located and carefully evaluated in relation to its compatibility with the body (Burpee, H., 2009).

Internal style effects

Internal designers around the world are experimenting with various approaches to changing single-occupancy design. Hospital rooms should be designed so that patients are more satisfied and heal more quickly (Alvarez, 2004). Instead of assisting in recovery, hospital rooms will have a negative impact on hospitalized patients and contribute to anxiety. When it comes to stress, (Petermans & Pohlmeyer, 2014) correctly points out that the physical space contains characteristics that can influence stress levels.

Positive distraction in health care space interior design, according to Jamshidi & Hashemi, (2020), is a component that increases positive feelings, reduces worrying thoughts, and relieves pressure. Stress is an important consideration when analysing

people's interactions and, as a result, the environment. Those who sleep in hospital rooms experience an immediate effect. Hospital rooms will validate people's expertise, wake them up, calm them down, and encourage innovative thinking, but they can also cause worry and discomfort.

As a result, the physical environment must be planned to support healing in the user's space. This study is to identify, and establish the internal components accepted by the public, in order to improve public satisfaction in hospital single occupancy rooms. Patients' preferences for the relevancy of nature, smart facility, acceptable wall colour, and art work, according to the investigator, will make them derive satisfaction and enhance wellness methods and mental health of the patient in hospital environment which is critical to the recovery process.

Fundamentals ideas behind the interior style

An interior designer has the potential to be a creator. World Health Organization transforms a concept into a physical purpose, and environmental healthcare for societies to use or move around in. The designer must learn about the activity that will occur in the connected setup and obtain information from the user who will be located in the area being designed (Phillips et al., 2010).

According to Alvarez (2004), design, planning, and implementation of patterns, floor planning, interior fixtures, furniture, and all building codes are considered.

Human Factors in Internal Setting and Sensing Environment

The “attractive setting effect,” as it is known in psychology, is a psychological phenomenon. It is believed that the influence of the pleasant environment is also linked to rooms in healthcare facilities (Martin & Guerin, 2006). Getting this principle clearly is critical and of additional importance in determining the comfortability of users in rooms and in moving outside acute care settings.

Human comfort and interior architecture

The interior design of the site was influenced by human comfort in the environment. Environmental comfort occurs once users are satisfied with their surroundings and have support for their activities (Susiarty, A., Lalu, S., & Suryatni, M. 2019). Environmental comfort is divided into 3 sections;

a. Physical interior comfort

Physical interior comfort can include elementary people's requirements such as cleanliness, and safety that can be met by adhering to building codes and standards (Susiarty et al., 2019). According to research, the aesthetic factor has a significant impact on our perceptions of our surroundings. The main dimensions of environmental aesthetics associated with physical comfort in hospital rooms are light, colour, artwork and furnishings. Designers must be aware of how people interact with their surroundings.

b. Functional interior comfort

The environment's ergonomics and support for the users of the space are linked to functional comfort. Ergonomics is the study of the association between the strategy used for building structures and the operators of an area (Cathy, 2004). User satisfaction is influenced by physical comfort; Vischer (2007), suggest that the design of equipment and furniture can have an impact on the user interface and thus improve satisfaction.

c. Psychological interior comfort

Psychological comfort is derived from a sense of belonging to one's surroundings (Susiarty et al., 2019). According to Gosling et al. (2005), personalizing the bed locality can assist users in adjusting to new environments, moderate social interactions, increase satisfaction through a location, and enhance emotional add-on to a location by reflecting their interests, abilities, personalities, lifestyles, and values. It is also necessary to identify patients' preferences relative to healthcare space (Susiarty et al., 2019).

Related Research

Table 4

The summary of related work

Main Subject	Aspect	Key Sentence	Scholar(s)
Healthcare Environmental Quality	Definitions	A generic term used to assess how patient feel about the spaces.	(Krokfors, K., 2017)
		The combination of environmental elements.	(Garbey et al., 2015)

	Significance	It is a key factor in promoting sustainability by addressing the impact of interior space healthcare characteristics.	(Han et al., 2019; (Susiarty, A., Lalu, S., & Suryatni, M. 2019))
	Factors	-Acoustics -Air quality -Lighting -Thermal comfort	(Stidsen & Fisker, 2009; (Karassavidou, E., Glaveli, N., & Papadopoulos, C. T. 2009)
Functional comfort	Definition	A building's level of comfort is a key factor for identifying its hospital characteristics.	(P. Radanliev and D. De Roure, 2021; Vischer 2007; (Martin & Guerin, 2006)
	Significance	The level of task support can be measured through systematic data gathered from healthcare.	(Hashemi, 2020; Burpee, H., 2009)
	Factors	Thermal comfort, ventilation, and indoor air quality. Lighting and environment Windows and daylighting	(Levin & Joseph, 2009; Suresh & Smith, 2007)
hospital design, technological development and its environment	Definition	Indoor plants and views of the outdoors are examples of natural elements that reduce mental strain and provide restorative value. The layout of the space and	(Yamaguchi, 2015) (Karassavidou, E., Glaveli, N., &

	furniture also influence quality	Papadopoulos, C. T. 2009)
	In terms of user satisfaction and work performance, green or sustainable buildings have different quality criteria than conventional buildings, with users in green buildings rating air quality, thermal comfort, and overall satisfaction higher than those in conventional buildings.	(Esfahani et al., 2018)
	Giving space more environmental control is referred to as environmental empowerment and it has an influence on healthcare well-being.	(Cho et al., 2016; Day et al., 2020)
	A habitable hospital must satisfy three areas of space user' needs: health and safety, functional and task performance, and psychological comfort.	(Suleiman Al-Khalidi, 2022)
Significance	Built environment is one that meets the needs of inhabitants and enhances their well-being.	(Mazuch, 2017)
	The significance of IEQ in enhancing sustainable development has led to an increase in the number of research efforts addressing this construct.	(Jamshidi & Hashemi, 2020)

	Factors	IEQ is important ideologically because it supports patient in living the best way they can in their environments.	(Chan, Wong, & Tang, 2020; Cortegiani, Ingoglia, Ippolito, Giarratano, & Einav, 2020; Gordon, Tchesnokov, Feng, Porter, & Götte, 2020)
		The built environment, including both indoor and outdoor spaces, significantly impacts human life experience (health, comfort, and well-being).	
		The health benefits of sunlight cannot be overstated, hospitals used to have large windows that allowed natural sunlight to flood the space.	(Ujanová et al., 2019)
		Positive distraction in health care space interior design.	(Jamshidi & Hashemi, 2020)
		Engineers are faced with a major obstacle in the creation of a good healthcare interior environment when it comes to these approaches to healthcare.	(Rengel, 2003)

During the year 2020, healthcare facilities were finding it difficult to meet the needs arising in hospitals as a result of factors such as increasing population, demographic shifts, prolonged livelihood, and better healthcare services.

All these calls for a wide range of reconstruction of hospitals all around the world and new novel technological advancement has been resorted to and these has aided the functionality within a hospital setting and improved the general wellness target of the users in a healthcare environment.

For instance, remote servicing, home treatment, and online help desk outline an increase in health services which is set up at the outskirt of convectional hospital arrangement. Despite the range of telemedicine, telecare, and telehealth that are available, there is still huge dependence by healthcare facilities on Information Technology which will be preferred as a solution to make them less dependent on each other. This Information technology (IT) solution will usher in future changes and serve to further boost the roles, functionality, and flexibility of hospitals all around the world. In essence, as more functionality is attained across the different settlements, will the full usefulness of acute healthcare centre.

For this write-up, two reasons have been identified as to why the existing hospitals around the world are gathering further support. The first reason is the obsession of the ordination institutions backing these hospitals with additional wealth to prolong the lifespan of costly, high-technology, and important medical equipment. This is a guiding principle that is still in use now to ensure the continual ability of these hospitals to deliver essential healthcare services. Since this period, the standard was set to allow the sustainability of this act and the emergence of new and advancing technology will only aid and further improve those already in place.

The other reason is advancement realized as a result of new technological practices introduced for healthcare. As an attempt to support this emerging trend, the National Advisory on Surgery opines that the most prominent passage into surgeries and laser technology has landed an upgraded hand to the rise of complicated surgical instances (Walley, P., & Davies, 2002). Intelligent healthcare should have a variety of intelligent healthcare components (Kirch, 2005).

The increment towards less invasive, complicated methods of surgical cases is liberated operationally with costly healthcare technologies. The most remarkable recent advancement is the input of robotics. It is predicted to increase universally in surgery because these robotic machines are capable of operating at a level of precision which may be impossible for man to attain (Blackman, 2003). Both visualizing and surgical services have become some important part of the functionality which is now well attributed to acute hospitals. While these two points are better watched, others should

not be handled with lenity including; staff, tests, and scans for quick assessment and all-day long Intensive care units (ICU) for post-surgical recovery. All these components should work with one another to ensure the goal of establishing an acute hospital is not defeated.

The use of the colour, silver in coatings has been ascertained to greatly limit the proliferation of bacterial diseases and also possess some effects on the environment which are well linked too (Leather et al., 2003). The use of other metallic elements and compounds for their innate antibacterial impact has also been well-registered.

Passive technology and Nanotechnology in the Healthcare

The physical and mental well-being of an individual is one that requires adequate attention and monitoring as it takes little effort for it to be infected and put down by illnesses. Some of these infections are contacted through the interaction with hospitals and other healthcare facilities, a development called healthcare-associated infection (HAIs). It is rather ironic due to the fact that people are actually infected. Germs are all around human life, in the earth, water, and on their bodies (Swan et al., 2003).

These infections may however be contracted via the physical presence of someone in hospitals or when there is contact with the ambulances for first aid services or any other HAIs of unknown origin. Healthcare design is a novel aspect of architecture that deals with the mental and social demands of man while carrying along relevant biomedical and economic components of wellness.

Interior design sort of incorporates essential components in the entire cycle of hospital structure. The finishing's and edges that are utilized when designing a healthcare facility do have significant impact on wellness of users and visitors (Gosling et al., 2005). The other components which include Floors, walls coverings, and its accessories equally play essential roles in a hospital setting.

This underlines the importance of carefully selecting finishing materials in the process of buildings or structural design. Nanotechnologies therefore serve as a useful tool in putting materials to better use in the field of architecture. The use of substances in Nano-length scale can enhance the features which they possess and ensure ways by

which they are properly utilized are well spread out. Table 2.4 presents the forms of Nanoparticles.

Table 5

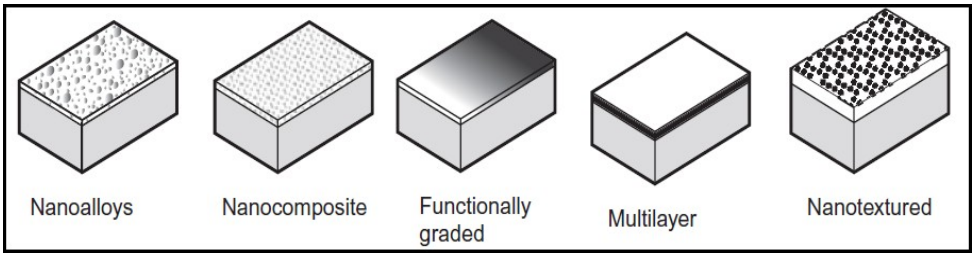
Forms of Nanoparticles in Construction and their Application

Application	Area	Nanoparticle Type	Major Application
Construction	Concrete	Silica nanoparticles	• Reinforcement in mechanical strength
	Concrete	Tatiana nanoparticles	• Rapid hydration • Self-cleaning
	Concrete	Carbon nanotubes	• Mechanical durability • Crack prevention
	Asphalt concrete timber	Aluminium oxide nanoparticles	• Increased serviceability and compression ability
	Brick mortar	Clay nanoparticles	• Increased compressive strength • Increased surface roughness
	Concrete	Iron oxide nanoparticles	• Increased compressive strength • Abrasion-resistant
	Steel	Copper nanoparticles	• Weldability • Corrosion resistance; Formability

(Raffa et al., 2010) A research which has been conducted on Nano-scaled materials shows that they are special materials with varying chemical and physical properties, has much effectiveness, and possesses better functionality compared to the well-known materials of same use. The introduction of this new and improved area of interior design to healthcare facility design will go a long way in arriving at a sane and healthy environment in healthcare facilities.

Figure 2

Types of Nano Coating Layers



(S.H. Alhmoud- 2022) nanotechnology can be described as the phenomenon of establishing tools and equipment by altering, reorganizing or reconfiguring of the structural make up of an existing substance or material including its molecules, atoms, and super-molecular that leads to arriving at a Nano scale level of control over any aspect of living.

Table 6

Application of Nanomaterial's in Coatings and their Functions

Nanomaterial (Types)	Function	Effect	Industrial Applied
Oxides: **- Titanium dioxide (TiO2).** **- Iron (II, III) oxide (Fe3O4, Fe2O3).** **- Silicon dioxide (SiO2).** **- Chromium (III) oxide (Cr2O3).**	- Colour effect. - Reproducible paints.	- Prevent crack formation. - Enhanced resistance to fading	- Construction. - Furniture.
- Organic/inorganic hybrid polymers. **- Colloidal /Nano silica silica embedded.** **- Silanes e.g. fluorine compounds.** **- Titanium dioxide (TiO2).**	- Self-cleaning	- Dirt & water repellent. - Anti-graffiti protection. - Protection against fungi and algae.	- Glass. - Construction(facades)
- Silicon dioxide (SiO2). **- Aluminium oxide (Al2O3).**	- Scratch resistance	- Enhanced scratch resistance	- Parquet flooring. - Furniture.
- Titanium dioxide (TiO2). **-Silver (Ag).**	- Photocatalytic effect. - Antimicrobial effect.	- Removal of grease, algae, dirt, bacteria, odorants, fungi, and pollutants. - Transformation of ozone and NOx into harmless compounds.	- Wood preservation - Glass - Construction (facades, tiles, noise barriers)
Titanium dioxide (TiO2).	- Fire retardant	- It creates a layer of carbon foam that works to insulate heat from the wood's surface, followed by a layer of ceramic that resists flames.	- Wood production against fire. - Construction.
- Titanium dioxide (TiO2). **- Zinc oxide (ZnO).** **- Iron oxide pigments.**	-UV protection. -IR absorbing.	- Control of indoor climate. - IR blocking. - Enhanced of UV resistance.	- Glass. - Plastics. - Wood preservation. - Construction (facades).

(El-Abbasy et al., 2017)

The definition of the term has been giving severally by various researchers by that which carries more weight and is more applicable is any of such which underlines the fact that the main concept is the changing of particles, i.e. it involves the gradual change or metamorphism on the characteristics of substances with a thickness (Rangel, 2003).

The coatings that rely on nanotechnology are made of the following substances, depending on the function that is required: titanium dioxide, carbon black, silicon dioxide, zinc oxide, iron oxide, silver, and other substances.

The function performed by Nano coatings extends to serving as an environmentally friendly and offers a befitting solution for protection against microorganisms and reduces the risk against fungal contamination and generally proves sanitary values. When considering the fact that the surfaces of the interior spaces in healthcare facilities are prone to contamination by microbes, the advantage which are offered by nanotechnology becomes welcomed in adding compounds with Nano coating properties on different surfaces in hospital environment is greatly important and can't gold more value. See Table 6.

The new nanometre materials challenge designers' thinking and promote the evolution of designers and interior design styles, and as a result of people's natural desire to seek out new materials, new Nano materials are increasingly "created," forming a virtuous cycle that has influenced and promoted the development of interior design. As a result, nanomaterials in building materials have a very broad market application potential as well as significant economic and social benefits. Further, removal of bacteria, algae, dirt, control of indoor climate, odorants, fungi, and pollutants (Chen, 2014).

The presence of microorganisms on the numerous surfaces in hospital interiors is the main problem. As a result, to benefit from its qualities and great performance, particularly against bacteria, Nano-coating is applied to a variety of materials frequently found in interior spaces, such as: marble texture: has a Nano coating that makes it liquid repellent, scratch resistant, stain resistant, and glossy (Colorado et al., 2020).

- Marble is liquid-repellent, scratch-resistant, stain-resistant, and glossy.

- Windows and facades are shielded from calcium buildup, hard water, sand, watermarks. Wood: It is more durable and shields the surface from water and UV light damage.
- Pure Steel: By bonding Nano coating to stainless steel, it provides gloss and additional protection.

Nano coating is an environmentally friendly and one-of-a-kind solution for long-term protection against bacteria, mold biocontamination risk, and virus, as well as long-term surface sanitization. Table 7 shows the characteristics and advantages of Nano coating.

Table 7

Self-sterilizing Properties of Nano-coating

Features	Environmental benefits
-Powered by light. -Works with natural, UV, and fluorescent light.	-Improves IAQ (indoor air quality).
-High performance; Long lasting effect.	-Reduces using of toxic chemical.
-Environment friendly; Harmless to human beings and animals.	-Reduces the risk of surface bio-contamination.
-Decomposition of endotoxin and germ body.	-Reduces the time of cleaning and disinfection process.

(Hosking, J. E., & Jarvis, R. J. 2003)

Emerging Technology and Healthcare

A computer revolution has been experienced in this age of existence which has affected and also has a telling influence in all aspect of life. The case is not different for the health sector. An appreciable level of advancement has been seen, which is the more reason why the sector is not in standstill progression-wise. This is telling in the major environmental settings and designs which has consequentially led to prominent spatial problems (Smith, L. G., & Anderson, M., 2010).

As a result, it was stated that a basic and rudimentary association exist between healthcare facility environment and technology (Hosking, J. E., & Jarvis, R. J. 2003). Even though it has been put forward due to strong and careful observe, there have been very few substantial evidences to cement this school of thought that the influence of

technology on hospital space is pronounce (Karassavidou, E., Glaveli, N., & Papadopoulos, C. T. 2009). The situations of things are getting different in that efforts are now been intensified to design technology and hospital space.

Establishing the basic relationship between hospital design, technological development and its environment

Just like the conventional design and mode of implementation of any viable structural aspect of the economy, a substantial level of progression is witnessed in the health sector. Past years has made the present times to be aware of the wave of growth that is generated which in turn is consequentially in line with the requirement of design science and hospital healthcare. The adaptability of the trend of design that is put out these days is a testimony to the realization of this day by the stakeholders in this field and more effort is therefore needed to buttress the set work that is already in motion and purportedly under continuous evolvement.

The ethics of shared pandemic risks in ethical health technology assessment and risk in vaccine supply chain

In a critical review of methodology and guideline approaches by (Radanliev and Roure), who researches and developed a paradigm for ethical considerations in digital supply chain settings, focusing on the accountability and transparency of cyber risks from IoT systems, integrating them into pandemic hospital infrastructure. In another research by (Radanliev and Roure) examines the potential risks of IoT in medical facilities and the ethical implications of shared accountability in healthcare policy. It highlights the challenges of implementing smart manufacturing technology due to cost and lack of cyber capabilities. The research suggests securing data in shared facilities, ensuring confidentiality and addressing privacy concerns, and ensuring well-trained healthcare personnel in cyber security and digital technology (P. Radanliev and D. De Roure, 2021).

Green Building Assessment Criteria

The BREEAM Green Building Assessment Criteria

The most used sustainability evaluation tool in the world for master planning infrastructure, buildings, and projects is BREEAM (Building Research Establishment

Environmental Assessment Method). The value of higher performing assets is acknowledged and reflected throughout the built environment lifespan, from new construction to in-use and renovation. By employing standards created by BREEAM achieves this through third-party certification of the assessment of an asset's performance in terms of its environmental, social, and economic sustainability. This indicates that BREEAM-rated developments are more environmentally friendly spaces that improve the wellbeing of those who live and work there, support the preservation of natural resources, and make for more appealing real estate investments. The purpose of BREEAM is to promote innovation and continuous performance improvement by establishing and evaluating against a wide variety of rigorous scientific standards that go above and beyond existing laws and practices. Build confidence and value among those who own, commission, deliver, operate, or use buildings, infrastructure, or communities so they can achieve their sustainability goals by offering impartial accreditation that exemplifies the broader advantages for people, businesses, society, and the environment. Currently, there are 2,310,077 registered buildings in 87 countries and 591,822 certificates that have been issued (BREEAM, 2017; Magrini, 2015; Mansour, O. E., & Radford, S. K., 2014).

Figure 3

BREEAM score rating

Assessment score	Assessment rating	Star rating
< 10	Unclassified	–
10 – 25	Acceptable	★
25 – 40	Pass	★★
40 – 55	Good	★★★
55 – 70	Very good	★★★★
70 – 85	Excellent	★★★★★
> 85	Oustanding	★★★★★★

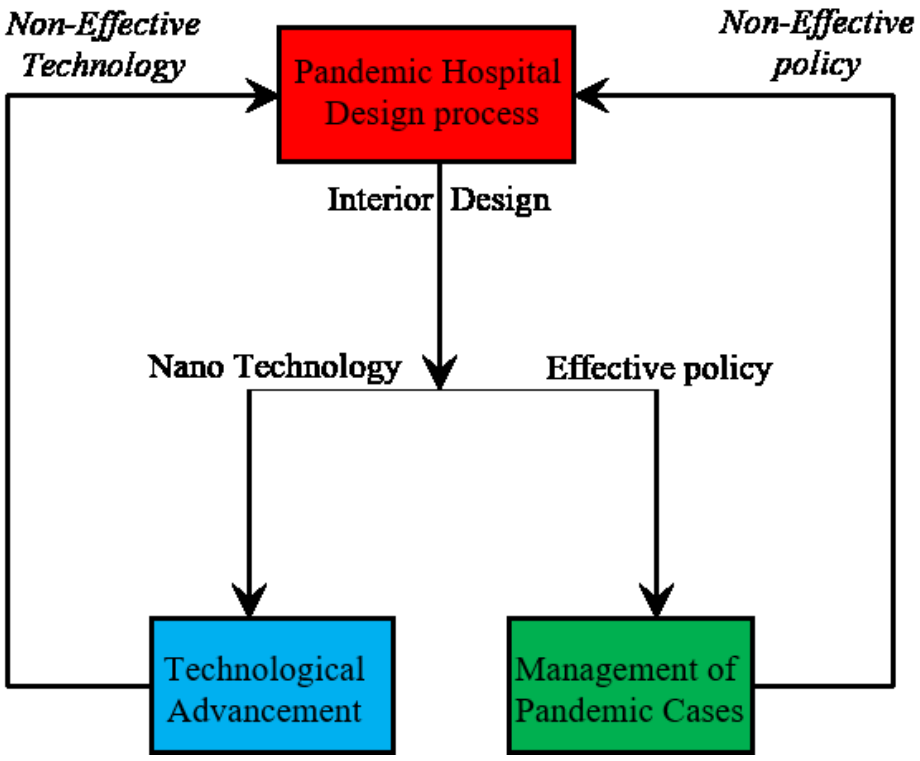
(Mansour, O. E., & Radford, S. K. 2014)

Conceptual Framework Processes

In chapter one, the two hypotheses were stated, i.e. H^1 and H^o, which were opposite to each other. These hypotheses were formulated to test the relationship between the variables in this research. The H^o stated that there is no relationship between pandemic hospital processes with the new technological advancement and management of pandemic cases. While, H^1 states the opposite of H^o, and the variables of this research were about three in number, which were both grouped in dependent and independent variable. The independent variable is Pandemic Hospital Design process, which has dependent variables as Technological Advancement and Management of Pandemic Cases. The pandemic hospital design process will be tested in relation to the two dependent variables (Technological Advancement and Management of Pandemic Cases).

Figure 4

Conceptual explanation of the framework



(S.H. Alhmoud -2022)

This research is focussing on the interior design of pandemic hospital in Jordan. In the figure above (Figure 4) the conceptual framework of the research is explained pictorially. Effective pandemic hospital design was the main target aim of this research in which Nano Technology was introduced in the interior environment, if it is effective and the required sustainable outcome was achieved the process will stop. However, if the desired outcome was not achieved the process will restart again. Same process is applied by the government policy in an effort to achieve an effective management of pandemic cases.

Definition of variables

The pandemic hospital design process as an independent variable has two moderators, which are effective Nanotechnology and policy-making which can be used to achieve the desired results in the two dependent variables in this research. This is because the policies formulated will design certain process and rule that has to be followed to fight any kind of pandemic either or the future pandemic. Nanotechnology can be used in ceiling, wall, and floor finishing easing cleaning and regular sanitation of the interiors of the pandemic hospital.

The dependent variables known as technological advancement and management of pandemic cases will be accepted when there is effective technology and policies applied in the pandemic hospital interiors.

Mediators and control variables in this research, which were mentioned in Figure 4 and the explanation of how they affect both the independent and dependent variables, will be done. The moderators here were Nanotechnology applications in the interiors of the hospital and effective policy-making in fighting against pandemics. However, the dependent variables might be affected by a number of people affected by the pandemic cases. The mediator variable is linked with the interior design process of the hospital and its management. This interior design connects the independent and dependent variables, which are more affected by the independent variables. This is because when the pandemic hospital design was changed to another different facility with a different function the nature of the interior design must also change.

In this chapter, the relationship between the rapid and tentative growth in the use and adoption of technology in planning spaces and the environment has been well detailed. The thesis has provided a solid theoretical and conceptual basis for which the course of technological advancement in the healthcare sector has morphed over the past century right into the 20th century.

To a great extent, healthcare depends on technological advancements as an avenue to save lives. To this present age, technology is not only useful in the fabric of hospital buildings but has become important to all operations, management and delivery within a hospital organization. Hence, Nano-materials are considered the best solution because all Nano materials can be used as a solution for different problems of finishing materials in hospitals and as it's shown the functionalities that are important to architects and interior designers.

Careful analyses of components for attaining flexibility in healthcare establishments were established. These include design planning, the principle of operation, indeterminacy and standardization. Each hospital types suggested by Aalto, Weeks and Le Corbusier, gives provides prerequisite information about an orderly service of healthcare plan models which provides reasonable way-out in a period of revolution in hospital spatial change.

CHAPTER III

Thesis Methodology

Research Design

The third chapter of this thesis centres on the methodology with which the entire thesis is designed. Two distinct methods were adopted which include the future prospective method and the mixed-method. The previous chapters have done justice to the major goal of this project work which has to do with seeking out the link that connects hospitals and technology with respect to carefully Nano-field healthcare of existing hospitals environment on future implementation of module hospitals. The guide to the choice and application of this methodology were the combination of the papers, write-ups, and publications that were reviewed in the 2nd chapter. In itself, this chapter highlighted the need for the ideologies of choice and the necessity that arise from such which make it imperative to develop or better still on out a similar working model which is closely related to that of two particular research i.e. Krawczyk and Radcliffe's Prospective. In other to arrive at a sound conclusion, a hypothetical scenario is to be idealised with fine tuning designs for future planning outcomes to be implemented in modern healthcare facilities.

To achieve the research's goal, both qualitative and quantitative approach will be used. The first step was the creation of questionnaire was created to test both the patient and stake holders. Following that, additional follow-up in-depth interviews with selected survey respondents was conducted to learn more about how hospitals dealt with the various stages of the pandemic and what lessons can be applied to future hospital projects to make healthcare facilities more resilient to virus-like pandemics.

Justification of Thesis goals

The first and primary Justification for this thesis is to plug and bridge the knowledge gap that exist in this field of study regarding hospital designs.

The scope of planning and environmental design in architecture and other design-related fields is well varied and broad. This may range from the execution of a Nano-field hospital campus to the design of a simple structured single patient-bedroom in an hospital or healthcare centre. The focus of this thesis however will be focused on a

single fraction of hospital design so as to direct its scope towards the creation of a blueprint with which larger environmental decisions can be based and also serve as a template for future hospital planning's. This decision was arrived at after considering some important factors.

For instance, the concept of patient-care design was deeply explored including discussions of surrounding the impact and necessity for implementing a new idea as it regards the handling of epidemic cases as the novel pandemic breakout in an event of any such occurrences in the nearest future. As a kin observer, one of many difficulties in designing such important module hospital can be attributed to the transformation in space usage and management which is in motion to cater for architecture design technologies.

Identifying research variables

The dimension of this research created a path for selecting research from five consistent criteria.

(i) Form of hospitals

The different structures which have been used or converted to emergence service units for attending to pandemic cases are of varying fundamental types and their typologies differ immensely between varied specialities. And as a result, the proposed module hospital will be such that can effectively replace any of the existing temporary hospital conversions.

(ii) Sample location

The location of the proposed pandemic centre was chosen to be close to a general hospital in Jordan. The site is located at empty site of Princess Rahma Hospital building, Zaki Al-tall street, Irbid, Jordan; even though the concept of module hospital to be initiated will be suited to different geographical locations and accommodate the need of design practitioners and their alike, there is the need to consider factors. Even with the relatively limited space which module hospitals are meant to occupy, providing such space within a densely populated and highly functioning neighbourhood becomes a challenge. Healthcare facilities located in urban settlement are faced with challenges which may include those linked to designs emanating from the need to expand and

limited ground area to work with while it is quite easy to handle such problems in rural areas and suburb (Marmion, P., 2012). For the purpose of this study, the prototype to be implemented will be suited to both forms of rural and urban locations.

(iii) Sample city

Irbid was chosen to be the city in which this research was carried out. Flexible designs are usually of varying architecture design and this necessitated the restriction of the size of the overall sample to which this study is subjected to. This study is carried out, even though; the idea of module hospital is to be adaptable to different clinical settings all over the world, the set limit is to ensure that the scope of the research does not become ambiguous and Jordan being a nation of relatively structured healthcare system in the Asian part of world becomes an important token point.

(iv) Architecture planning flow type

There exist different forms of complex movement in and around a typical hospital, thereby creating a lot of flows. Part of this is the movement of outpatient visitor and that of the non-clinical staff. As the scope of this study is limited to the kind that is associated with the sections that are contained in a module hospital and this centres around quarantine, stabilization, and the entire management practices relating to pandemic.

(v) Specifications in hospitals

It is good to state that architecture design technologies are:

All the designs, planning space methodology, together with the overall structural systems employed in providing them (Rosen, C. S., 2000; Rosen, R., 2002). The choice of technological variable which that is discussed in this thesis is that which are closely related to materials commonly used in interior spaces to take advantage of its properties and high performance, particularly against bacteria.

Factor that impact on hospital plans and models

When it comes to putting a design in place for a hospital, the blueprint goes beyond centring it solely on architectural considerations. It is important to note that several determining factors produce into the eventual actualization of a healthcare environment which further increase the complex nature of designs encountered in typical

conditions. Taking the healthcare policy that is presently in use in the United Kingdom for illustration, it is well stated that attention should be put on the reduction of number of beds, another modus operandi in some Nations of the world commonly referred to as the soviet model of hospital setting required that an increased number of beds is maintained (McKee & Healy, 2002).

Each aid policy drives a unique typological response, supporting the argument that different factors influence the look of module hospitals. This principle directs consequent identification method that centres upon crucial all dominant hospital style factors.

Reflective hospital style processes, this procedure informs the realm of architecture design coming up with on paper. Through in small stages, processes determine the healthcare design (Novak & Godwin, 1984).

Research Framework: Healthcare Preparation in Hospitals

The goal of this research work is actualized through the execution of its core points in parts i.e., methodology and method.

According to the Oxford dictionary, methodology is defined as a system of methods used in a particular area of study or activity, while method is a particular procedure for accomplishing or approaching something, especially a systematic or established one. Explained below are the methods and methodology which are adopted and utilized for this for this research work;

This has to do with making findings into single components of healthcare settings within the amplitude of architecture. With respect to this, the methodology employed for this thesis is such which sees a lone methodology to be a perfect fit to proffer solutions to the problems which the research initially set out to solve which have been carefully underlined in the 1st chapter of this write up. In other to come up with befitting foresight of the state of the healthcare space in the near future, there is the need to come up with a solid comprehension of the present state, the factors affecting its position and the path on which it treads.

Coming to the reality, it is not possible to set a pinpoint for the future. However, a more feasible way out is to evaluate the peculiar threads for the future (Orrell, 2007).

If this is to be adopted, there is also the need to also come up with a sustainable methodology. This is essentially why this research study has tapped into the progressive findings on future studies which are well related to the field of interior architecture and hospital design (Krawczyk & Ratcliffe, 2005).

The methodology developed by these writers is arrived at through the conceptual framework utilized in business planning. The token points encapsulated in this strategy functionality and flexibility depicts a sustainable architecture environment design is achieved by putting in place a prolonged path of action and strategies.

Basically, strategy can be defined as a set of measurements put in place to arrive at a specific goal (Esfahani et al., 2018). The idea of strategic planning gained headway as a form of analytical method adopted in research around the 1960s which will provide necessary competitive dimensions in a company setting and also to align the goals and targets of a company in the proper direction (Zhang et al., 2019).

The newest debate on adaptable hospital design has been sparked by architectural products from the recent PFI (Private Finance Initiative) process. One major fear regarding PFI hospital facilities is that these 'cutting-edge' surroundings will 'Within five years, it will be defunct,' among other things (Gates, 2005). Theoretically, this area investigates adaptable hospital layout to prove its requirement as a part of the overall design to construct effective Building lifespans in hospitals, in order to bolster the validity of this opinion. This basic investigation is motivated by a fear of future technology development, which foresees medical revolutions that will revolutionize future medical practice. The ability of hospitals to respond to change is determined by their flexible options, throwing up the possibility of PFI NHS (National Health Service) acute hospitals becoming obsolete before their time.

The term "architectonic adaptability" is generally defined as follows, according to Griffin and Roughan's interpretation: Flexibility refers to the capacity to move around the edifice, a range of purposes during the course of its existence, many of which may not have been envisaged at the time of conception. Indeed, the diversity of purposes will

point to some kind of the 'universal' construction type that may be adapted to modern functions to justify the investment and avoid unnecessary and premature demolition within its shell (Griffin and Roughan, 2006).

The capacity to translate these requirements into a set of adaptable hospital design principles is critical in assessing the long-term viability of PFI NHS hospitals. As a result, the focus of this section is on defining these medical planning tenets. Flexing hospital architecture, feasible design solutions are not a novel theoretical phenomenon. As will be demonstrated, throughout the discussion of hospital design in the twentieth century, a number of forward-thinking architects emphasized the critical need that hospitals need to be more flexible. To assess the applicability of their hypothetical implications to PFI NHS clinic typologies, the work of Alvar Aalto and Le Corbusier, two Modernist architects, informs the thesis, John Weeks, a healthcare architect. Their hospital types were diverse selected because of three factors in particular. They represent variety of hospital design templates from the twentieth century, for starters. They were, second, created with the goal of providing flexible design options. Third, and most crucially, when compared to more hospital designs from the twentieth century reviewed. All of these hospital typologies are discussed in Chapter 4, provide medical planning solutions that work. Each typology is looked at separately to see why all three architects agreed on a single overarching strategic principle: flexible the importance of solutions in the construction of effective hospital buildings cannot be overstated.

Many typologies represent twentieth-century hospital architecture, however to address the issues raised, only templates that were relevant to the long-term viability of PFI NHS hospitals were worth investigating. Hospital typologies were grouped into three categories based on their chronological order, each of which has three key characteristics: to reflect alternate medical planning methods, conceptual innovation, and adaptable hospital design solutions. Throughout the 1900s, there were long periods of stagnation in the construction of British hospitals. As a result, European hospital typologies had to be considered.

(i) European models were adopted in the United Kingdom. The design preparation at this hospital had as a result of the lack of recommendations, he was

unavailable for critical evaluation. The Paimio sanatorium, on the other hand, is usually considered as an original design by Aalto and has had a significant influence on later designs.

(ii) Hospital design in the mid-twentieth century by introducing new vertical architectural shapes and new modern architectural forms. However, by the time the NHS was planning its hospital development, things had changed program, and it was already too late. Architecturally, this design model had developed. British healthcare architect John Weeks was one of the architects who was able to put his thoughts into practice at the time. Northwick Park Hospital in the United Kingdom incorporated architecture of the present day and the newly founded The National Health Service has evolved into a new hospital typology. The first and last national hospital building initiative in the United Kingdom, within the context of contemporary PFI NHS design, the relevance of this typology is considered crucial.

TAlvar Aalto designed the Paimio Sanatorium in Finland

Finland's expanding healthcare infrastructure in the 1920s led to the establishment of multiple hospitals. Similar to the current hospital construction in the United Kingdom, A competitive method was used to commission Paimio's new sanatorium. As Paimio became famous and acknowledged as generally significant, the winning design 'launched Aalto into the international elite of architecture." (Schildt, 1994). Paimio's medical planning strategies are responsible for the success of this revolutionary sanatorium model. Aalto's design was carried throughout the hospital.

The success of Paimio's functional evolution can be explained by two key characteristics: As adaptable hospital design solutions, Strategic separation and decentralized standardization in Aalto's version.

(i) Strategic separation: A ward block with a linear layout with a distinct solution and administrative building space is designated as Paimio's notion of strategic medical planning. A linking distinct Access points, as well as horizontal and vertical circulation, are all part of the communications block connects the two. Furthermore, two structures in the back-house departments that provide support services. Paimio's

medical strategy planning idea, according to the thesis, is an example of both practical and architectural design isolation. Paimio's strategy, according to architectural historian Winfred Nerdinger, is as follows: The division as well as distinction of numerous functions into a distinct and unique structure pieces that retain their own character while being subordinate in relation to the overall scheme of things (Nerdinger, 1999). Aalto's approach on how a structure should be maintained was this medical planning model; to adjust to the user's requirements. Paimio's theoretical medical planning paradigm is greatly influenced by this separation principle, which Aalto promoted as a strategic flexible design option throughout his career. In particular, in his 1930 Zagreb hospital design, Aalto used the same medical planning technique.

(ii) Decentralised standardisation: 'Form always follows function,' as Louis Sullivan observed, is reflected in Aalto's architectural design approach (Sullivan, 1896). This fundamental premise of functionalism, in which the shape of a building is determined by its intended use, Aalto's beginning Paimio gets a bonus point for his attention to detail was notified. One of the key by-products of the machine era is standardization. was pushed by Aalto in order to obtain a flexible design, rather than being relegated to the drab and tedious usage of reduplicated forms, must be employed to acquire the maximum amount of 'flexibility' and variation (Pearson, 1978; Lim S, Hudson S, 2003).

"The contradiction between standardization and the need for uniqueness and variation," according to Aalto, should be resolved using a "decentralized" standardized approach, in which "The objective of standardization is thus to develop feasible variation and richness, rather than to aim at a type". Aalto was concerned about human utility, which he believed was devalued in today's hospital designs. Into this approach (Aalto, 1940). To elucidate, Aalto argues "Making architecture more human means better architecture," according to The Humanizing of Architecture, and that "true from a human standpoint, "functional architecture" must work (Aalto, 1940). As a result, Aalto campaigned for the design of hospitals that is operationally responsive to human orientation, for example: (i)'People standing horizontally occupy a room in a hospital';

(ii) in the hospital, patients are in the "worst-case scenario." (Aalto, 1940) These important design with the patient in mind factors prompted Aalto to create a slew of decentralized Paimio's standard details All of the information was gathered through medical planning replies on scales of 1:200 and 1:50 Aalto's intention to design a hospital that is versatile and flexible that satisfies the needs of weak, ill patients is exemplified by two instances.

The first example is the belief of Aalto in the importance of the patient's experience. For example, rather than architectural elements, Aalto concentrated on "his efforts to tailor the facility to the patients' most minute physical and mental requirements" in an inauguration brochure (Schildt, 1986). Paimio's most conspicuous architectural element is Aalto's strongest reaction to patients' demands. The overhanging ward balconies provide access to personal exterior spaces for all in-patient rooms. The Medical planning and architectural form of a hospital at a scale of 1:200 incorporated and continues to incorporate this is a direct response to human requirements for natural light and fresh air. This design element is critical to human psychology and well-being, and it will always be important. Years of deep-spaced windowless hospitals have come to an end 'leading-edge' EBD (Evidence Based Design) claim that natural light and vistas hospital facilities, both patient and non-patient are essential.

The second illustration of Aalto's decentralized standardization came in the form of precise technological solutions: The concepts of standardization as a means of aiding industrial construction and standardization as a means to gain variation and flexibility by humanizing standardization. According to functionalist ideology, Paimio has "the most effective and efficient entrenched In Aalto's own work, functionalist traditions are evident" (Pearson, 1978). Paimio was so well-designed that, according to Goran Schildt who is an art historian. "Every feature of the architecture served a clinical purpose and was an element of the therapy" (Schildt, 1994). The commitment of Aalto to offer uniformity transpired in around 100 design components. 'As heating and ventilation systems, daylighting arrangements, lighting fixtures, color schemes, and noise-reduction inventions,' customized door knobs, and so forth,' says architectural writer Peter Reed. (Nerdinger, 1999). The Paimio Chair by Aalto and a noise-reducing patient wash basin

are two examples of Paimio's 'flexible standardization'. This chair, which was created to help tuberculosis sufferers breathe easier, shows Aalto's attempt to make Paimio "work as a medical tool" (Schildt, 1994). As a result, rather than being an unsustainable quick-fix solution, the individualized attention to detail that Aalto is known for has been welcomed as a driving force. This focus on the human element has resulted in lasted but it has stood the test of time, it was ignored Many previous NHS PFI hospitals were found to be invalid, potentially invalidating them. Later PFI designs included efforts to create flexible and adaptable hospitals with the utilization of uniform room types and the simplicity of equipment. This standardization technique will provide functional, therapeutic, and geographical alternatives in the future akin to Aalto's Paimio Sanatorium's adaptable design solutions.

To summarize, as a strategy for dealing with pandemics, adaptable both strategic and internal medical planning have found design solutions. This praised hospital design can be used to help tackle future medical planning issues, such as pandemic. Paimio's strategic medical planning principles, on the other hand, were developed for a site that is both green-field and extensible that may or may not be as adaptable to a typical urban situation (Jamzadilalarukh et al., 2018). The following type, which was inspired by Paimio's medical planning strategy, is investigates a British urban hospital location and the medical planning problems that come with it.

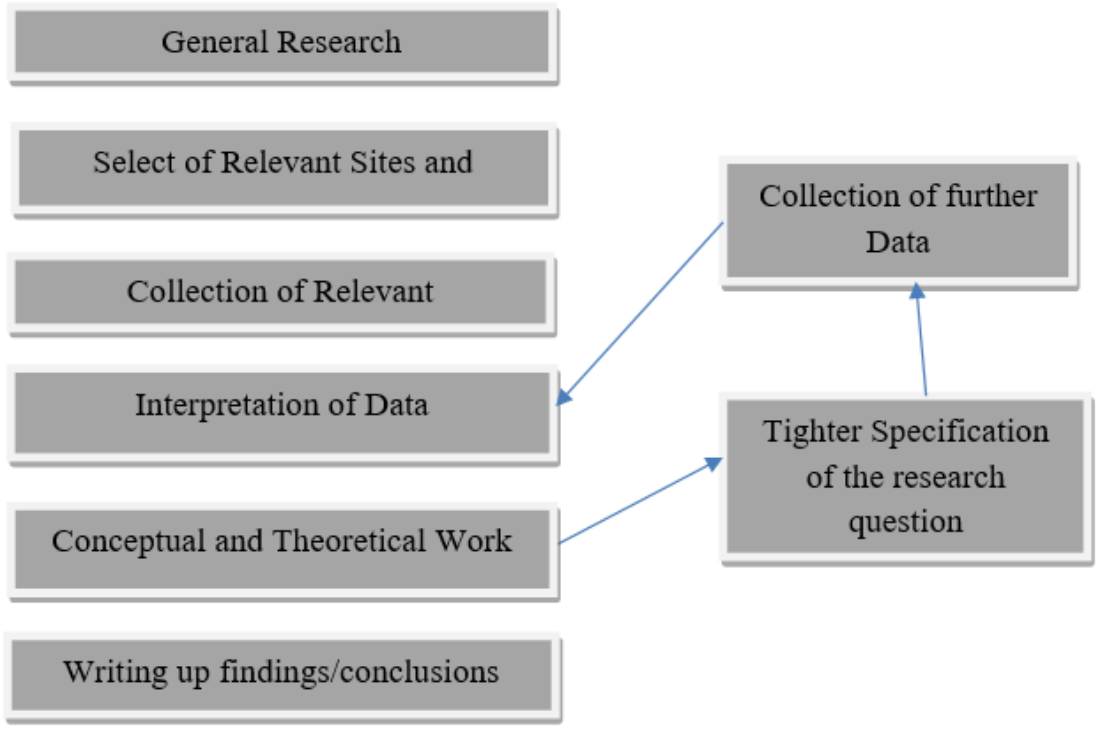
Participants / Population & the Sample / Study Group

Practice-based Research

According to Gherardi (2012), practice-based research has grown into a qualitative research method, this, in turn, might be defined as a "data collection and analysis technique that prioritizes words rather than numbers" (Bryman, 2012). Figure 5 depicts the main processes in qualitative research.

Figure 5

Steps in qualitative research Source:



(Bryman, 2012)

Research Participants

The questionnaire will serve as the primary starting point for a national assessment of pandemic preparedness and hospital building changes during the various stages of the outbreak. One of the benefits of using a survey is that it may be delivered in large numbers at the same time, the questionnaire is short and easy to complete, with the majority of the questions being closed-ended. Furthermore, respondents will find the survey comfortable because they may complete it at their leisure and at their own pace (Bryman, 2012).

The Jordan National Institute for Public Health and the Environment's database, which contains 68 health organizations and 117 hospitals, was used, and it was supplemented with the profiles of specialists in the field of hospital facility and real estate management in Jordan. To increase the response rate, the survey was distributed

by e-mail and face-to-face in coordination with the engineers' healthcare department managers. Respondents got an introductory e-mail with information about the study's goals and a link to the survey. In addition, the survey was publicized on the internet for two weeks in order to boost response rates. The survey was created using software and takes around 10 minutes to complete. It focuses on hospital working methods and building changes during the pandemic.

In-depth interviews with chosen survey participants are also suggested as a second approach of collecting qualitative data to better understand the survey results. The framework of this method is adaptable. The early study concepts are more open-ended and allow for reflection on the crisis era gaining a better knowledge of the decision-making process and the choices made in terms of planning and adaptations. The interviewees' perceptions are more crucial in this technique, as is getting thorough answers on how the interviewee interprets or deems relevant specific situations or events (Bryman, 2012).

As a result, online video interviews with specialists in charge of hospital building operations, such as facility managers, will be established. The goal is to gain a better understanding of the emergency response during the pandemic and to look at new developing initiatives that could help to future-proof healthcare institutions against viruses like pandemic. With the respondents' prior approval, all interviews will be anonymized and recorded.

Questionnaire Description "Hospital during Pandemic"

Only general information on working habits during the epidemic was asked in the survey, which was divided into four sections. Basic hospital building characteristics such as the year of construction, address, and kind of hospital were previously entered into the database, as a result, respondents do not waste time filling out this type of data. In addition, the in-depth interviews included context-related questions about the pandemic response.

The first area, as shown in table, is for the respondent's general information, the second section discusses pandemic working processes, the overall characteristics of the institutions, as well as their pandemic readiness. The third section focuses on the various

adjustments made to the buildings in response to the outbreak. Finally, the fourth section discusses new initiatives that have emerged as a result of the pandemic. The following sections are explained in further detail:

Table 8

The sections that included context-related questions about for pandemic response

I. General information: The purpose of the questions regarding the respondents is to obtain non-identifiable data that will help to characterize them. **II. Outcomes measures:** A. Working Methodologies – Pandemic Operations • Cohort nursing and non-cohort nursing are two different types of nursing. • Capacity approach: Outplacement of patients • Distinguished locations: facilities committed 100 percent to pandemic and non-pandemic care B. Characteristics of the hospital (objectives outcome measures) • Number of beds • Number of ICU • Number of single-patient rooms C. Pandemic preparedness (Subjective outcome measures) • Pandemic preparedness 1st wave • Pandemic preparedness 2nd wave • Pandemic preparedness British variant – 3rd wave **II. Measures are taken during the pandemic** These variables influence outcome measures and are classified into three main categories composed of eight or nine interventions. • Building interventions • Technical interventions • Staff services **IV. Future overview** This section aims to reflect on the future necessities of future-proof healthcare facilities to a virus-like pandemic.

(S.H. Alhmoud- 2022) the survey results are expected to give an overview of Jordanian hospital measurements. The findings chapter will look at the association between emergency response metrics and hospital spatial factors such as building year, hospital type, and population density. Furthermore, the survey's final questions are planned to provide a preliminary summary of what components should be addressed in future hospital design.

Data Collection Tools / Materials

Interview protocol

The interview's participants and questions were chosen based on the survey's previously collected data. The goal of the seminars was to learn more about the emergency response context and decision-making process. The purpose was to reflect on the crisis period and analyze the major challenges and lessons acquired during each organization's experience. The interview process was created with four primary subjects in mind, as stated in table 9.

Table 9

Main Interview Topics

1. Prepare for a crisis in the context
2. During the emergency reaction, strategies and procedures were developed
3. Logistics alterations
4. Facilities' long-term prospects

(S.H. Alhmoud- 2022)

Processing data

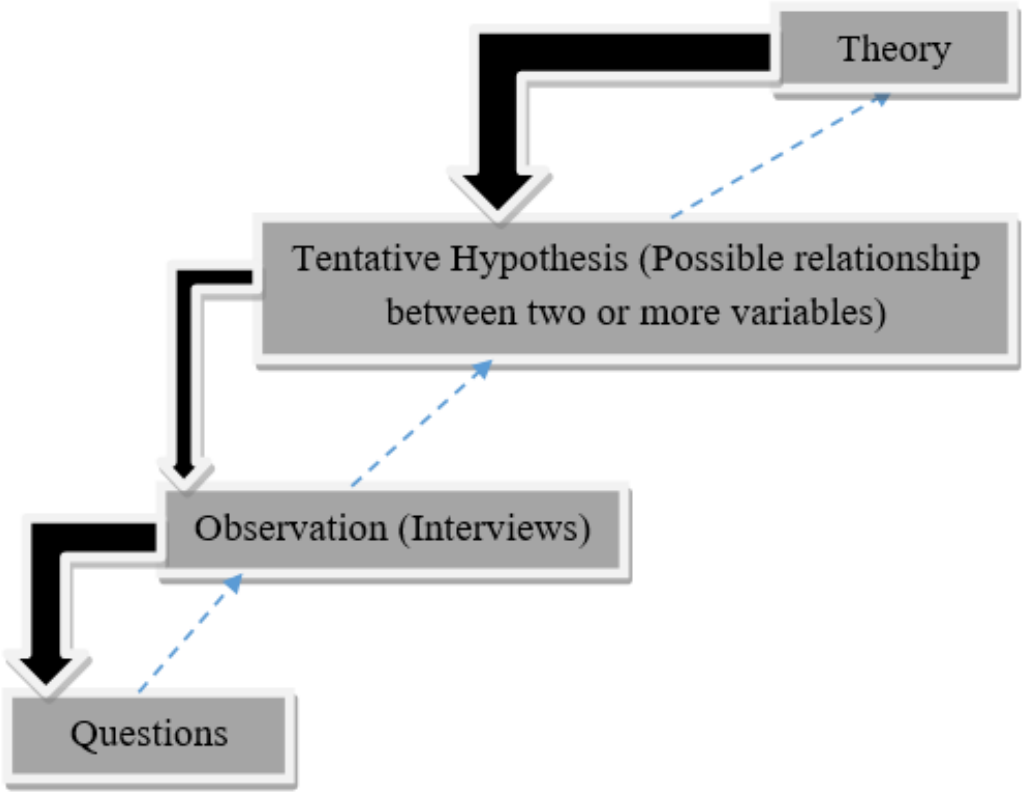
SPSS software is recommended for the display and descriptive analysis of the data collected in the questionnaire. To detect patterns and illustrate the data obtained in the survey, timelines and histograms are employed. There were no additional statistical analyses performed, hence the survey analysis analyses should be regarded qualitative.

Because little is known about the studied phenomena, an explorative inductive approach (shown in figure 6) will be utilized to analyze the interviews. This method

entails examining data with little or no prior theory, structure, or framework, and using interview data to answer research questions, allowing for interpretation (Burnard et al., 2008).

Figure 6

The structure of an inductive method



(Koolwijk, 2020)

All English interviews will be labeled using the ATLAS program after each interview session. Through the thematic content analysis technique, this tool is utilized to manage and assist in the analysis of the obtained data. The key methods for analyzing the transcripts, identifying themes, categories, and relationships between variables of interest in the research, and developing tentative hypotheses and recommendations for future hospital design will be open thematic coding (Burnard et al., 2008).

A student of the French by the name Godet in 1990 came up with a novel 'strategic prospective' model titled "la prospective" which makes a unique distinction between the laid down way out in literatures and the plan setting itself (Godet, 1991). The idea behind the initiative is to recognize all the possible influencing factors of the nearest future and is well adjusted for as long as they can be (Zhang et al., 2019).

Table 10

Five for Strategy of Management

Strategies	Strategy Description	Relevance to Thesis
Plan	Forward planning progressive action	Relevant
Pattern	A view at actions of the past and pointing out a correlation	
Perspective	How management depicts the goals of establishment	
Position	Correspondence in architect environment	Irrelevant
Ploy	Correspondence in architect of direct competitors	

(Mintzberg, 1987*)*

As against, planning centralizes on concentrating objectives with solid bases around the immediate future to find out a fulfilled future perspective. As suggested by Godet, the concept of planning is largely narrowly carved for establishing long-term strategies. Based on this study, a thesis layout design methodology well suited for exploring typical hospitals in managing epidemic cases.

In contrast to this, the typology that was utilized in this study is by the duo of Thorpe, K. E. (1987), with its core revolving around a backtracking flexible design and regional planning in a comprehensive module. One of the essential reasons why this methodology was favoured for adoption is because of its 5 phases of experimentation that exist, there is one which allows for forecasting future eventualities.

By contrast, the need to develop a future oriented methodology is arrived at as form of necessity through the visual evaluation (units/square meters) (SQM) of and healthcare environment. This has subsequently led to the research in this case to develop a working module which seems from that of Krawczyk and Radcliffe's 'Prospective'. This methodology arrived at with the idea of contributing largely to the pool of

knowledge in interior architecture and general hospital design. As well as implementing a sustainable template for the successful management of pandemic and any other unforeseen pandemic disease of the nature.

Evaluating the impact of technology as a major determinant in Hospital Design planning

Technology has been at the forefront of development witnessed in the health industry and also planning has a role in the architecture design of hospital structures and other components. However, there are scanty research works that explore the relationship with respect to Jordan and if at all there are, are not readily available. Spatial requirements are gradually addressed with every new hospital plans that are implemented factoring in the need to actively involve technological advancements; technology's impact in shaping hospital environment is still quantitatively unexamined.

Investigating the likely implications of the introduction module hospitals for future pandemic disease treatments and associated hospital spaces

From the extensive content of out literature review, there exists no empirical work to analyse future implications has it has to do with space of module hospital. Thus, a proper analysis of the idea of introducing this form of flexible design facility and its possible impact on future hospital space is imperative. The case of pandemic has taught the world a huge lesson of how unprepared an unexpected case of pandemic disease can catch up with the existence of people and be a destructive force in the smooth running of life and even though the case has been well managed this time around, being proactive will go a long way to ensure the securing of lives and properties.

As regards this, a scenario approach is applied to visualize how each model of module hospitals will impacts on hospital space and its key components. This has led to research towards visualizing future hospital design remedy as a viable closing point.

The study is directed towards conceiving future hospital design with nanomaterial's planning solutions in which the objective of the final thesis can be evaluated.

Evaluation of the need for flexible hospital design solutions

The 4th objective of this research work is centre around getting grip of possible solutions which can be adopted by putting in place smart healthcare design which can

come handy when tackling pandemic cases of diseases. The rapid advancement of technological improvements in this past decade has underlined the need to marry the latest trends in technological with any progression in societal development. This study is conducted by relying on the data that appeared during the thesis to search for a design for a new module for the pandemic virus.

Additional contribution of knowledge into the layout which is already available will allow the available module hospitals for treatment and management of pandemic cases to be assessed and will alert of the need for smart way-out in healthcare systems. The thesis concludes to provide some Function recommendations for future architecture design planning strategies and a new module with guidance on criteria.

Data Collection Procedures

The objectives of this research revolve round the evaluation of the state of existing hospitals or better still, buildings converted to pandemic treatment facilities with a view of creating a template for the construction of module hospitals which will be well suited to addressing the need for hospital admission and healthcare services administration in the case of pandemic and also any unforeseen pandemic of disease. With respect to this, the research design of choice is to be organised in a way that collects and subject data to analysis which mirrors these points. A 3-phase working approach is chosen and they are listed below;

Section I: Thesis frameworks and structure.

Section II: Evaluation of the present state of pandemic centres (hospitals and makeshift structures) around Jordan with respect to our case studies.

Section III: Exploration of module hospital ramifications with foresight for upcoming healthcare facilities environment and creating blueprints for module hospital designs that can be implemented for effectively tackling pandemic cases of diseases.

The mixed approach and stepwise methodology of evaluation and analysis will have a say on future design setting studies considering that knowledge is shallow in this end.

Quantitative Framework: Case Study Sample

In the first part of the study, sample of functional pandemic centres in Jordan were identified and selected to be the case studies and they include;

i. Pandemic Field Irbid Hospital

ii. Pandemic Field Zarga Hospital

iii. Pandemic Field Ma'an Hospital

iv. Pandemic Field Prince Hamzat Hospital

Together with these, hotels and other precious residential and non-design buildings that were converted to pandemic holding and quarantine facilities were also turned in.

The aim of the case study is to quantify the nature of hospitals in Jordan and the effort which has been put forward in tackling the effect or pandemic in the society. There is the need to evaluate Jordanian hospitals that are built over a long period of time which are still existing and functional and those of this generation in a bid to get a grasp and their inherent capability to response to cases pandemic cases. The choice of case studies also made it possible to pinpoint several hospital characteristics and that hospital design planning for the new module with criteria of nanotechnology.

Three inquiries are asked for each Jordan hospital case study;
(i) How well are hospitals in Jordan faring in the battle against pandemic and the position are in tackling another unforeseen pandemic case and essentially determine if there is any need to put the use of module hospitals into full swing?

(ii) Is technology growth rightly and supposedly measured and quantified?

(iii) What are the trends and relationships that are manifested one way or another between high and low-tech areas?

Data Collection

The data of the study was collected from various sources, which included different timelines and procedures. Principal data will be collected from a government official, workers at non-governmental agencies associated with health of the nation and its citizens, health workers (staff, personnel) and patients of individual hospitals with the

aid of questionnaires and interviews will also be carried out to establish a basis for the implementation of module hospitals through those that are actively involved in the health system. This will allow the study to take a significant route toward the achievement of its set objectives and prioritize the use of module hospitals in housing and caring for pandemic cases and any other unforeseen pandemic cases.

Data Analysis

The data analysis devised in this research was multi-dimensional analysis method. In chapter 2 the literature review was conducted and the result was summarized in chapter four. The data fetched from the questionnaire was analysed using a combinations of computer software like Statistical Program for Social Sciences (SPSS), Microsoft Excel and MATLAB. Microsoft Excel will be used in data collection and organization of the data, being it a more user-friendly and very good in calculations. The data was transferred to SPSS software for proper statistical analysis. Mean, mode, median and frequencies were done using the SPSS software. MATLAB software will be used to analyse complex data and make comparative analysis of two different variables in the study.

The data will be presented in two main categories; i.e., data presentation inside chapter four (data analysis) and data analysis during final presentation jury. Data presentation in chapter four will be done using mixed methods. This implies that the data here in this part will be presented in both pictorial or graphical and tabular forms, through the use of tables, charts, pictures and shape drawings from various computer applications. The computer applications that will be used in this part was Microsoft Word, PowerPoint and AutoCAD shape files. Similar data presentation will be followed during final jury presentation, though here PowerPoint application will be the major software that will be used to present the data.

The Case Studies

A single faceted scope is employed derived from diverse spaced evaluation inherent in design templates of existing pandemic quarantine and isolation centres. This is what informed the choice of the analytical method to be a single quantitative approach.

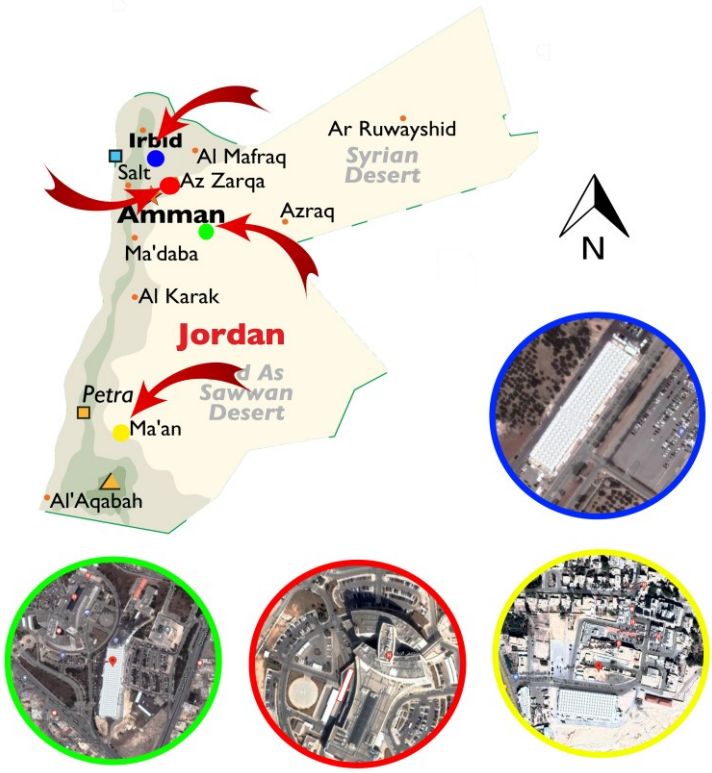
The choice of this method is that it gives a wider scope but firmly jointed set outcomes with respect to hospital space. Data to be measured were defined to lead to a decisive point of thought in the attempt to identify the method is to provide a backing to past outcomes support for quantitative prior findings and end points by showing that the research embarked on is well placed through comparative quantitative analysis.

Figure 7 depicts the geographical location of the study sites, which are spread across Jordan's 1 largest and most populous cities. They are located on the country's coast and share a border with Palestinian cities.

For the case studies, four hospitals were selected to act as case studies. 1 of these hospitals was selected from Irbid which is the second-largest city in the country of Jordan and 1 from Amman, the capital city; while 2 of the hospitals that were selected from Zarga and Ma'an, as well as the different components of the hospital building including the ward or sectional forms.

Figure 7

The Location of the Geographical Map of the Study Sites



(Google map, 2021)

Through this methodology, the research was able to streamline its findings towards, with respect to the case studies selected for this research; the set of data gathers included measurements represented in metric form per sqm to arrive at uniforms value of a unit of data. In general, results of areas of places taken were unit or section based to aid evaluation and are either of the 4 headings listed below;

1. Top technology
2. Reduced technology
3. Management planning in pandemic
4. Structure management.

Data Analysis Procedures

Description of case study

a. Case Study 1: Pandemic Field Hospital Ma'an

The Ma'an hospital is located at Ma'an, Jordan, beside Ma'an Government Hospital. The hospital covers an area of 4400 square meters, with a capacity of 48 intensive care beds, and 198 regular beds.

Figure 8

Map of the Ma'an Hospital & Hospital Photo

(Google map, 2021)

Table 11

Indoor Description of the Ma'an Hospital

	
a: A sample multi bedroom ward	**b:** A sample patient ward
	
c: A four-bedroom patient ward	**d:** Laterally placed four-bedroom ward

(S.H. Alhmoud-2022)

b. Case Study 2: Pandemic Field Hospital Zarga

The Zarga hospital is located in Amman, Jordan, beside Prince Hashim Bin Al Hussein Government hospital. The hospital, established on a 5,200-square-metre plot of land, was directly implemented by the Military Works and Housing directorate within 14 days and was equipped with all necessary equipment with a capacity of 300 beds.

Figure 9

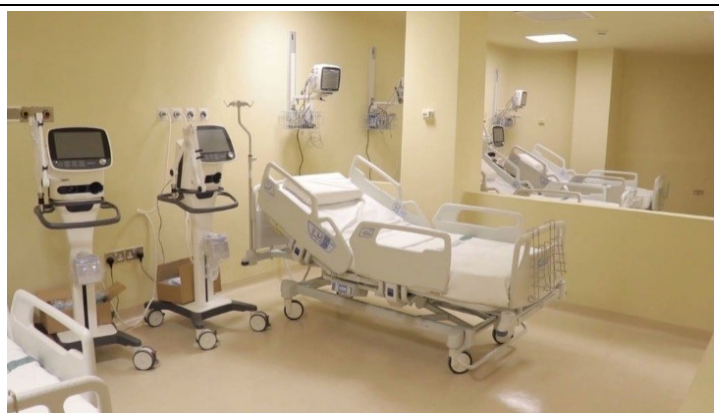
Map of the Zarga Hospital and Hospital Photo

(Google map, 2021)

Table 12

Interior View of the Zarga Hospital

a: Passage linking patient's wards **b:** A multi bedroom patient's ward



c: A sample Intensive Care Unit (Unit)

(S.H. Alhmoud-2022)

c. Case Study 3: Pandemic Field Hospital Prince Hamza

Prince Hamza hospital is located in Amman, Jordan, few distance away from the Cairo Amman Bank Cab. The hospital was built in 30 days on the premises of Prince Hamzah Hospital with a capacity of 408 beds, including 84 intensive care beds. The hospital covers an area of 5200 square meters.

Figure 10

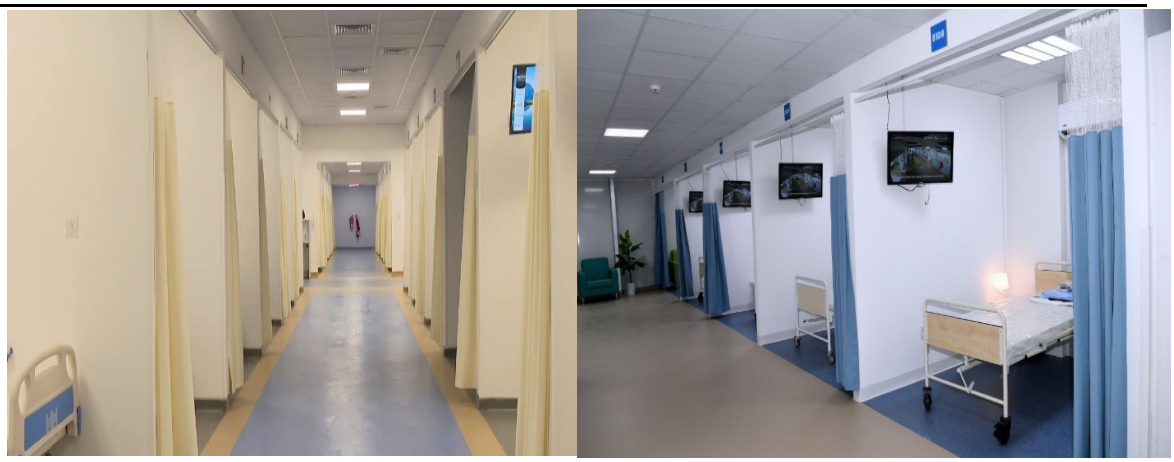
Map of the Prince Hamza Hospital and Hospital Photo

(Google map, 2021)

Table 13

Interior Demonstration of the Prince Hamza Hospital

a: A life support unit	**b** Picture of a multi bed patient's ward showing the walkway in between



c: A typical multi bed patients ward partitioned with wooden extensions

d: Compartmentalised patient ward

(S.H. Alhmoud-2022)

d. Case Study 4: Pandemic Field Hospital Irbid

Irbid hospital is located at Irbid, Ar-Ramtha, Jordan, beside King Abdullah University Hospital. Upon arrival at the field hospital, established on the grounds of the Royal Medical Services' Prince Rashid bin El Hassan hospital, King Abdullah was received by Chairman of the Joint Chiefs of Staff Maj. Gen. Yousef Hneiti and toured the hospital. The field hospital, covering an area of 4,650 square metres, has a 300-bed capacity, including 48 intensive care unit beds and 18 intermediate care beds ready to be converted into ICU beds.

Figure 11

Map of the Irbid Hospital and Hospital Photo

(Google map, 2021)

Table 14

Interior Demonstration of the Irbid Hospital

a: A multi bedroom patient's ward	**b:** Picture of a multi bed patient's ward showing the walkway in between

(S.H. Alhmoud-2022)

Table 15

Self-created Single Future 'Prospective' Methodology

Formulating a problem-solving question
Having a clear knowledge of the historic and current happenings
Pinpointing important issues akin to the current state of healthcare facilities
Identifying the determinants in the design that leads to such features
Comprehending the correlation between these design factors and healthcare settings
A delve into probable future happenings
Determining factors that influence change
Identifying major trends that will most probably shape the future
Create scenario logics
list different scenarios
Recommendations for the execution of proposed plan and course of action
Generating proposals for probable course of action and making design recommendations for the implementation by team members

(S.H. Alhmoud-2022)

First part has to do with getting a clear picture of current happenings and that of the past which serve as important determinants in influencing the designs of an hospital. This is achieved through the reviewing of past publications and documentations with a sound quantitative approach to back the out one which are derived thus.

The other part involves the setting of focus on case studies which has to do with the evaluation of advanced pandemic and other pandemic disease-based treatment and management centres. The information to be collected from this will allow the research to conduct a comprehensive comparison between the present state of technology in the treatment of pandemic cases in the present era as well as serving as driving force in healthcare settings and designs.

This concluded by creating a scenario or hypothetical situations which arises from the determining forces in healthcare/hospital designs which have been pointed out earlier, results of data analysis in the case studies identified with and also future projections**.**

Reliability & Validity / Trustworthiness

The concluding part of the method which is adapted for this study is visualizing the future technology design with a new module of architecture design. From the analytical result arrived at, the research will be primed to establish a thorough scenario principle.

The major importance of scenarios is so as to aid and guide stakeholders and decision makers to seek a differing route consequently enabling them to set apart activities of this day from eventual outcomes (Zhang et al., 2019). A basic example of the scenario method is the proposed plan architecture design. The principal goal of the scenario creation in this study is to better comprehend the essence of designing typical module hospitals on any other unforeseen breakout illness.

Table 16

Thesis Scenario Formula

Modified scenario for thesis
Identifying the major influencing factors
Creating a scenario logic
Developing planning varying scenarios

(Ratcliffe & Sirr, 2003) the concept of scenario creation as a possible methodology to be adopted in driving hospitals the analytical proposals in this thesis are; scenario thinking; scenario logic; scenario building as the length of this study does not make for the execution of any proposed plan in the real-life eventuality, the third component is excluded. However, the scope of this study is not extended to this point, contrary to this; it is to arrive at every feasible future for the treatment and proper management of pandemic and any other unforeseen pandemic case of disease as such. As a result, the sort of scenario is centred on hypothesizing series of future design plans.

a. Scenario building

Stating in comprehensive terms, Scenario logics means:

The structural ideas served as the basis on which varying scenarios are established. This are centred around the determine factors together with current propositions and postulations on the mechanism of world functioning (Zhang et al., 2019). The maim essence of this is to create viable structure and horizon for scenarios by making attempts to better understand the determinants of restructuring. Some of this said determinants are super forces and shocks, both of which will not be considered within the context of this work.

One force is central to this study: the basic components of a facility to be used or even considered to be suitable for the treatment of patients (symptomatic and asymptotic) of pandemic illness. The focus of this thesis shifts towards implementing a widely recognized and accepted raised standard, which will result into structural incur spatial changes considering all possible impeding constraints.

Structures Susceptible to Modifications

Any structural facility that has been either in use or idled with time may one way or another eventually surpass the lifestyle of their design and as a requiring some sort of renovation or rehabilitation as the case may be. In other to scale the danger that is posed waring out structures along the period of their usage, there is need for essential repairs and maintenance works to be performed on the mat regular intervals. These maintenance works are usually required because many structures may have been designed according to building codes which may have gone through modification or upgrading along the

years, therefore demanding that the structural components of such built facility be strengthens.

A fundamental issue that arises with regard to structural failures and leading to buildings requiring modification is poor land usage system or wrong site selection decisions. Major concerns come into play when buildings are to be erected or modified in places with significant history of seismic activities, swamp areas, expansive soils and also permafrost regions in the temperate world. When good choices and decisions are made regarding the site for erecting a structure, it also rests on the engineer in charge to be able to get his designs right and rid himself of mistakes which may include oversight of some loads, inadequate detail in connections, calculation errors, error in the use of a computer program amongst others. Another point from which a structure can and in essence making it vulnerable to modification is either in term of wrongful usage or the use of wrong or non-compatible materials or better still, operational error. These are errors that are beyond the influence of the designer. They include making structural changes to buildings without necessarily consultations, alterations in use, negligent overloads beyond the carrying capacity of the building and poor maintenance culture.

Air quality and pandemic

Maintaining a good quality of air that flows in and out of a built environment or apartment space can go a long way in reducing the level of contamination which can be transmitted and contacted through air. However, it is essential to note that this does not prevent people from contacting pandemic. But the Centres for Disease Control (CDC) or health organizations in different nations across the world have arrived at measures that if practiced religiously including use of face masks, filtration, social distancing, can greatly lessen the probability of its contamination within an enclosed space.

The use of air cleaners and other HVAC filters is to rid the air that circulates within a room of the pollutants it harbours. Filtering and subjecting indoor air to cleaning will aid in eliminating contaminants and other substances that likely serve as carriers of microorganisms, an example being the virus carrying particles. It is however essential to know that if there is to be effectiveness in the use of air filters in a space, for it to eliminate microorganisms, it must possess pores which will only allow the passage

of particles smaller than the size of microbes (i.e. ranging from 0.1 - 1 micrometre) (Pan, Y.; 2021).

Indoor environmental quality (IEQ)

The concept of IEQ is not a straightforward one as it covers all aspects of different situations that influence the condition in a space (Steinemann, 2017). These situations are those that are able to have effect on the comfortability and general wellness of the people that occupy a space. A lot of factors influence the happenings within a room such as biological, physical and chemical influences which may not be present within a space, but having their way as an external element, and aerated pace for example where air flowing in from the surrounding environment have an effect on that within (Cho et al., 2016). Biological factors include microorganisms whose growths are encouraged by moisture or water spillage in their cultural media. When the inhabitants of such a space are unfortunate enough to be exposed to these disease-causing microbes, the result may be either of several adverse health conditions (Katoto et al., 2018). Physical factors include the elements of the environment that directly or indirectly influence the condition within a space and how the occupants of such space react accordingly. The chemical factors include contaminants and dangerous compounds from gaseous emissions and other sources.

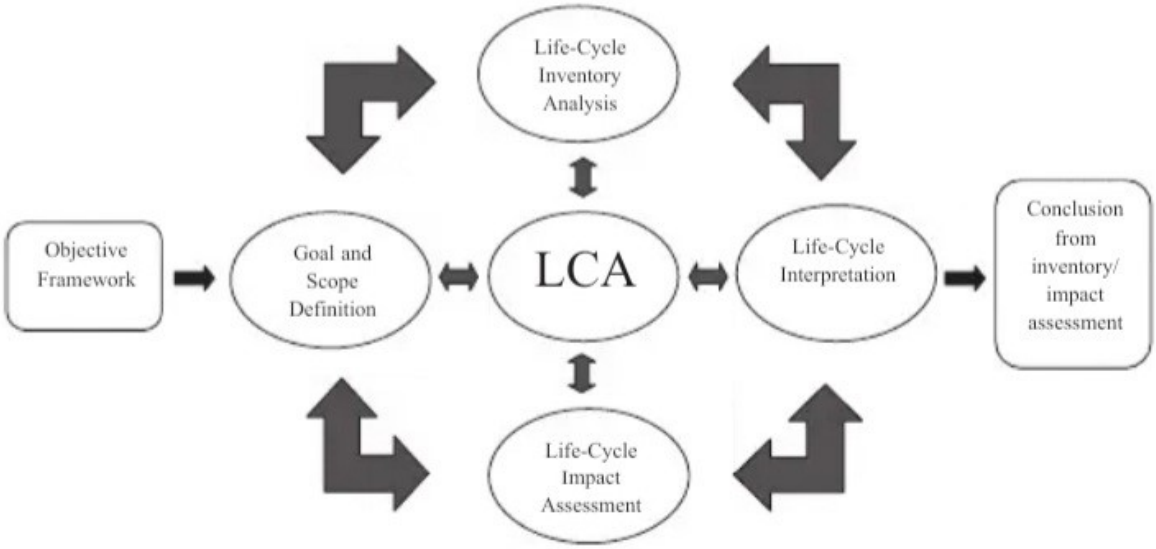
Lifecycle assessment analysis of buildings

Environmental concern is a topic of interest and one which has warned the attention of nation planners and decision-making agencies and environmental organization around the globe. These issues include but not limited to global warming, climate change rise in C level, design extension etc. Also, findings have shown that these problems are constantly either changing entirely or metamorphosizing due to different actions and activities which human subject the environment to (Schmier et al., 2016). As far as these issues go, prominent ones such as global warming and climate change which are both the resultant effect of the constant and unmeasured release of carbon monoxide into the environment. Energy consumption and burning of fossil fuels are well associated to the inhabitants of man and land. Buildings and housing structures in general play a major part in the use of energy. This energy usage may either be direct

or indirect as it stretches through the lifecycle of a building from its construction to its demolition (Porwal, A. 2013).

Figure 12

Stages of Lifecycle Assessment



(Sharma et al., 2011)

Lifecycle assessment is a tool used for the quantitative measurement of the materials used, energy flows and environmental impacts of products. This is an effective tool that is employed to test, evaluate and examine the varying sections that are related to the lifecycle of a product before it reaches the end product together with the effect of such product through its existence from being a raw material, till usage and then its disposal.

Analysis of Nanomaterial in Structural Creation and Improvement with Respect to Sustainability

The broader sense of the terminology presents us with the term "technology" which is the application of matter in a refined way to enable an effective and faster performance at any stage or sector of human activities and existence. The prefix "Nano" on the other hand means 10-9 i.e. a billionth of a meter. Nanotechnology therefore, can be defined as the ability to understand, take control and manage matter at this level and dimension.

In the modern-day construction industry, the major raw material includes steel, concrete, brick and timber. Of all these, timber is the only option which exist by nature and as a result, do require a lot of time for its readiness thereby, limiting its usage or patronage as a choice for construction. Steel and concrete can be manufactured industrially. Steel on its own, is a very reliable choice for its flexibility and durability, albeit it's very expensive to produce. While concrete can be relatively cheaper than steel, it can also be produced in Mass at low cost. However, the usage of these materials does require a lot of additional materials such as the need to galvanize, paint or protect the materials with cathodes to guide against oxidation and in essence, enhance the structural integrity of the structure. Also, there's a need to add cementing material in the production of concrete. The summation of materials involved from production, usage to demolition of these materials contribute largely to the depleting level of natural material which as a result not reclaimable, making their involvement unsustainable.

The choice of building material is the point where nanomaterial comes in. Nanotechnology can be used together with native building materials which will lead one to obtain structures of longer life span with excellent functionality. The lower density and higher strength properties of nanomaterial inject a new impulse to the market growth of high- tech.

a. Environmental, Social and Economic benefit

The usage and adaptations of nanoparticles as housing and construction materials has the tendency to boost the performance and overall features of resulting structures and therefore, sustainability.

Most of these materials have been subjected to high level of wastage especially in advanced cities that have experience revolution on a large scale in regards to build structures. This has largely negated the housing reform that has greatly supported the cycling. Therefore, they have been calls for improved plan to be followed such that the materials that are resulted from construction works should be gathered and distinguish into those that are best destroyed and those that can be recycled. The latter form of materials will become of valuable use during another set of construction works. An advantage of this is that concrete with Nano particles have been confirmed to be of

improved comprehensive strengths compared to those that are not made up of nanoparticles.

Table 17

Evaluation of Case Studies According to BREEAM Criteria

Criteria	Pandemic Field Hospital Irbid	Pandemic Field Hospital Prince Hamza	Pandemic Field Hospital Zarga	Pandemic Field Hospital Ma'an
Indoor Air Quality and Pandemic	o	-	-	o
Thermal Comfort and Cross Ventilation	o	+	o	o
Visual Comfort and Indoor Lighting	-	o	-	-
Quality of Outdoor Space	-	o	o	o
Silica Nanoparticles	*	*	*	*
Tatiana Nanoparticles	*	*	*	*
Carbon Nanotubes	*	*	*	*
Aluminium Oxide Nanoparticles	*	*	*	*
Clay Nanoparticles	*	*	*	*
Iron oxide Nanoparticles	*	*	*	*
Copper Nanoparticles	*	*	*	*
Indoor Environmental Quality	+	o	o	o
Accessibility	o	+	+	o
Suitability for Conversion	o	-	o	o
Acoustic Comfort	-	o	o	o
Ease of Cleaning and Maintenance	-	-	-	-
Environmental Impact of Construction Site & Process	o	o	o	o
Fire Prevention	+	+	o	+
Infection Control	o	o	o	o
Technological Advancement	-	-	-	-
Physical Atmosphere's	o	o	o	o
Emotional Responses in Healthcare	o	+	+	+
Ventilation in Healing Process	o	o	+	o
Human Factors in Internal Setting and Sensing Environment	-	-	-	-
Prevent the Spread and Formation of Bacteria	*	*	*	*

(S.H. Alhmoud-2022)

The table above shows the evaluation of 4 hospitals according to the BREEAM criteria as explained in the literature review as; Excellent (+) very good (o), poor (-), and not exist (*).

The scores above in Table 17 represent the level at which each individual institution incorporate the guides of design planning to provide an easily adaptable model which will require little time and resources in its establishment with its purpose not being defeated. As well as the essence of this study is to qualify the abstract and genuine take of people about the state of major pandemic field hospitals in Jordan and propose new designs of facilities that can further strengthen the hold of the nation and put it in better stead when it comes to handling future cases of a pandemic outbreak with much emphases on current pandemic outbreak.

Furthermore, the building contractors that are tasked in all the cases above took a lot of effort to ensure that the necessary features are put in place. These are however regarded as the strong points to be considered when installing a building in this modern age which will be employed by Jordan may serve as an essential purpose of quarantine.

Table 18

Comparison Assessment Between the four (4) Case Studies

S/N	Case study	Lighting	Access-ibility	Circu-lation	Capacity	Venti-lation	Functi-onality
1.	Pandemic Field Hospital Ma'an	-	F	o	-	-	F
2.	Pandemic Field Hospital Zarga	-	-	F	-	-	F
3.	Pandemic Field Hospital Prince Hamza	-	F	o	-	-	F
4.	Pandemic Field Hospital Irbid	-	F	F	-	-	F

(S.H. Alhmoud-2022)

While “o” means good, “f” means fair (neither good nor bad), “+” (plus) mean excellent, “-” (minus) means poor.

Table 18 above compares the assessments of the four pandemic centres, i.e., Ma’an, Zarga, Irbid and the Prince Hamza pandemic hospitals. There a lesson learnt

from these case studies which will be taken into consideration in the new proposal pandemic design of health centre required in this thesis. Natural interior lighting was poor in all the 4 hospitals. The first case study used here was Ma'an pandemic centre located at Ma'an hospital in Jordan/ this hospital was rated with poor natural interior lighting and ventilation because the building has no windows in the patient's rooms. In order to have cross-ventilation and enough lighting in the interior building, each patient's room must have at least two windows (according to BREAM criteria). Likewise, the capacity of the building when compared with the overall population must be at least 2,000 patients in order to tackle the pandemic situation in a country, according to World Health Organization (WHO) and American Organization for Nursing Leadership (AONL, 2022). There are 12 governorates regions in Jordan having a total number of 10 million population, 116 hospitals with a total of more than 14,000 beds, and 650 ICU beds. This gives an average of 121 hospital beds per each of the 116 hospitals in Jordan (Suleiman Al-Khalidi, 2022). Therefore, these 4 hospitals do not have adequate existing hospital bed capacity for patients to overcome the pandemic situation in the country. In term of accessibility Ma'an, Prince Hamza and Irbid hospital has good accessibility within the interior of the hospitals, while Zarga has poor accessibility. Interior circulation here only Zarga and Irbid has good interior circulation, the rest were rated as fair. Lastly, all the 4 case studies were rated fair in terms of functionality of the overall structure of the hospitals. These and more elements and factors were the ones that would be taken into consideration in the new proposed hospital building that would be present in chapter 4, solutions to all of these problems would be shown above, while alleviation will be the last option when a problem was found and cannot be solved. The overall assessment of all the building falls under unclassified in the BREEAM assessment table.

Limitations

Major areas are noted that are most possibly going to pose challenges to the smooth completion of this study and they revolve around data collection and analysis.

Usually, when hospital buildings are designed, they are made without preparing a plan for the flooring. Even though provision was made to accommodate this lapse, a set of inconsistencies still and managed to creep into some of the analysis in this study.

Additional procedures were generated via statistical manipulations. Majority of buildings fall short of most of these limitations therefore having no negative influence on the objective of the study in bridging the gap in design planning knowledge.

Having made a clarification of what necessitated the creation and adoption of a modified model which was worked with, the nature of the methodology has made it possible that there is a chance of being bias in eventual use. Even though the biasness may be unwelcome, it is highly important so as not to limit the scope of research and instead, broaden its perspective over the probable future advancements in the treatment and management of pandemic diseases.

The methodology which was utilized in the execution of the study is sort of novel and not commonly found around. Although none was found, the reason for its unpopularity may be because it allows for biasness and provide no opportunity to make inferential comparison with similar studies. This method was selected to ensure that the selected scenarios are trustworthy through the provision of substitute futures that possess widened vision with respect to space management and not limited perspective of developing module hospitals.

The limiting factor is the availability of adequate information on the first-class advanced stops in medical facilities. An upgrade is being witnessed in the area of plans and architectural designs and it has also seeped into healthcare sector as well. Novelistic approaches have been arrived at and there are reasons to believe that the introduction of new ideologies is not bound to end now. It is therefore a challenge to arrive at plans and designs for module hospitals which will not only stand the test of time, but also be as effective on the long run as it was in this year 2021.

The choice and mode of delivery of the entire framework of this research work is embodied in this chapter and it is marked as a single future-orientated ‘prospective’ methodology and mixed-methods approach. As a means of achieving the thesis objectives that were stated in the first chapter, a thorough look at the past literatures in the field of interior architecture paved way for the creation of a modified research hospital design. The origin, components and phases of this methodology arrived at is well explained and detailed stepwise breakdown of this is also made in the course of the chapter. Finally, a quantitative case study was selected and adopted for the execution, analysis and subsequent evaluation of the data collected.

CHAPTER IV

Data Analysis and the Hospital Interior Architecture Process with 3D Proposed Module Design for New and Improved Jordan Hospital

Findings and Discussion

This chapter provided an avenue to work on the identified measures that can serve as possible upgrades and advancements on the existing facilities especially hospital space that will go a long way in assisting in the fight against pandemic and any other unforeseen pandemic case of illness. The suggestions to be initiated will also be in line with the on-going trend and will be useful and adaptable to a different part of the world. Even though references are made to Jordan with respect t to the level of difficulty that was faced in the event of the eventual outbreak of pandemic, a much wider scope is to be covered in the study as hospital design process that will consider the necessary components of such structure will be explored. Talking about the elements that make up a hospital environment, the designs that are to be placed inside a room are as important as the space that they are to assume. Especially in this period when designs now perform a much-increased activity in a healthcare facility like some of the hospitals of the world, a typical hospital process design should have made provision for this in perspective. Buildings can be adaptable and flexible, as well as responsive to design process rhythms and patterns. This chapter examines the characteristics as well as the ways to encourage a state of well-being and quick recovery from depression. After taking a critical look at the aims of this research study, a questionnaire and a complex process were designed to align with the set goals.

Designing of Smart Hospital Interior Architecture Structures

In the construction of buildings and renovation of existing ones, most especially hospital interiors which are meant to house and provide wellness conditions to people, it should be designed to control its own temperature, airflow, and light as part of the complex processes. A building to be able to manage its usage how it operates and function should always be the priority when designing a healthcare facility process. Starting from the energy usage, this should significantly be lesser than that which it produces. As one of the resource persons interviewed mentioned the House Zero was

redesigned at Harvard University in 2016 by a scholar who is extremely knowledgeable in constructing replica energy conservation, and invention of sustainable structures (Garofalo, 2020), every component of the structure is designed to requirements for all aspects of wellness and sustainability. The heating, ventilation, and air conditioning system harnesses its energy from nature, rather than tightening up the building, preventing outer air from gaining access, the constructing protector was revealed in order for the structure to "associate with as well as to act in return to its natural world in order to encourage effectiveness and mental balance".

For the indoor environment, buildings that are completely cut off from the outside world rely on engineering heating and cooling systems. These systems use a lot of energy and don't do a good job of regulating IAQ. Engineering systems largely recirculate stale air in a space rather than replacing it. Passive ventilation systems, on the other hand, use the power of breeze and resilience for the purpose of inducing clean air indoor while maintaining thermal satisfaction. The building operates in its redundant state by inducing fresh air through openings in the building envelope, such as vents, ducts, vents, and operable windows.

Malkawi's design is reminiscent of how buildings were designed prior to the intervention of systematic design and construction of design buildings, "Buildings were planned with a comparison of windows to floor plate which is dependent on climatic factors" According to Michael Murphy, built structures were well positioned in temperate climes and regions for the accumulation of energy in the form of electromagnetic radiation emitted from the sun via windows facing south and to employ connatural adverse aeration methods to modify warmth and cold requirements in the range of a place. Hospitals were also constructed with walls and materials that are of thick sets in cities like Cambridge, Massachusetts. "An indefinite large quantity of concrete were used with the floor as an intermediate in quantity between the stories during the process of renovating, to maintain quotidian temperature from nocturnal to diurnal and occurring every season towards icy winters and hot summer" according to Jonathan Shaw. House Zero's "brain" is made up of preceptor and wire ropes that gather up in large amount of data points daily in order to regulate the inner environment. The information is accustomed to speed up a series of designs that will cause the building to

improve, reconfigure, and harmonize its operation every day depending on future weather predictions. The operation uses input about climatic factors such as temperature, rain, wind direction, and internal carbon oxide stage and airflows to open and close the building's windows and shades. Studies show that the data inputs collected, monitored, and adjusted by House Zero have an impact on good living and wellness. This same model however when readjusted to meet important specifications and requirements, becomes a suitable template (Tong et al., 2016).

Buildings and Spaces that Support Infection Control

Smart buildings involve using the incorporation of technological advancement in the design process to help lift such space above infection of any kind. While just any form of building may not find it particularly important to adhere to the principles of smart buildings with respect to the functionality of such buildings as Hospital building infrastructure (Bujanowska & Biał, 2011).

Diseases spread with ease in any environment where adequate preventive measures are not put in place to curtail their spread. Where cases of a certain pandemic disease are at the least suspected, it is usually best to mark places based on the prevalence of such disease as high-risk zones are from low-risk zones because this will ensure an individual is weary of movement. Altogether, such methods will aid the ability of people to read and understand space to operate rather effectively within them. There is a high chance that these methods will be in use till pandemic has been effectively controlled. Eventually, these methods still serve as ready-made designs for preventing future disease flare-ups or pandemic outbreaks.

As submitted by a participant, hazards can be better guided against by putting in place preventive measures instead of counting majorly on the public to limit their level of exposure. One of the ways by which this can be done is by ensuring that hospitals that address pandemic related diseases are not the same as those for other cases of emergency and health services. Whenever this is not possible, sections of the hospital for isolation and quarantine services should be sited relative away from other wings of the hospital where emergency and other non-pandemic cases are.

Smart Built Structures

Just as the entire world was dealing with the unexpected cases and surge in the number of pandemic reported, hospitals and healthcare facilities were quickly occupied and the available spaces to manage the numbers that were obtained each passing day were impossible. As a result, efforts have been made all over the world to find existing buildings in the region that can be temporarily converted for the purposes of design screening, triage, and patient care. Alternative care sites were considered for adaptive reuse at sports venues, convention centres, hotels, and dorms.

Putting structures into more substantial use involves the conversion of buildings that were previously meant for something else for other use. Hotels as a form of illustration were converted into quarantine and isolation centres when conventional hospitals and healthcare facilities were overrun by the cases that where been recorded in Jordan.

Better Hospital Architecture Design Process

There is presently a unique style of building which is generally compliant all over the world and Jordan included which is a suitable and relatively acceptable model. This model is popularly called the pavilion-style hospital. A normal detachable healthcare facility structure is an out-dated (3-4 stories) building constructed with U-shaped rooms irradiating from a middle passageway. Despite this, provision was still made for some important elements of the design including gardens, trees, and courtyards, allowing users to connect with their environment. These facilities were not particularly tall in a way that they could fully utilize air movement and ventilation, with the patient's rooms positioned in a way to take advantage of natural light. Rows of beds were surrounded by windows on the inside of the wards to maximize sources of illumination, a mental image of nature, and transverse ventilation. Every design decision was made with the intention of treating the hospital's architecture as part of the treatment.

Hospital structures were subjected to change by the early twentieth century. With the introduction of modern technological innovations and curative specializations, the healthcare structure started to be viewed as a "facilitator for current medical behaviours and practices," rather than a "medical instrument." Elevators and heating, ventilation,

and cooling systems were also introduced, which influenced how these structures are operated and their overall functionality.

A developing group of research has confirmed what the constructor of the detachable building of hospitals already learnt from hypothesis and mental perception, that the constructed surroundings have a significant impact on wellness and good health. This study is essentially carried out in a variety of fields, including building design, based design, and building science. Evidence-based design now encompasses a large portion of research. The built environment has an impact on user's distress, user and staff security, hospital and admin efficiency as well as top-notch care in healthcare settings according to this study.

Yuhgo, (2015) discussed how patient's window, light and flora filled can circulate airflow from within to the gardens, the reduction of bacterial infections by trees and increase in length of stay in hospital. According to a research carried out by the Centre for health design, it has been deduced that there was a benefit in the hospital for people who walk through and spend time in hospital gardens.

Interiors That Can Breathe

The widespread pandemic has reignited discussion about the importance of an interior environment wrapper in control of infection. The various components of the structure that separates the interior of the environment from the surrounding of the building envelope and the building envelope are currently treated as a hermetic enclosed box. Structures that are "leaky" are sufficiently tight to reduce energy consumption rates. Opening a window is an easy way to get rid of polluted air and give room for fresh one in case of a pandemic.

Building envelopes that allow "interiors to breathe" are now being advocated by many architects. Structure that are susceptible to leaks in this perspective, possess good health value. Many scientists view these clusters of infection as proof that the virus "lingers in the air indoors, infecting those nearby". Interior spaces like relaxation centres are typically dark and stuffy, with little fresh air coming in from outside. Using a "mixed-mode" ventilation system is one way to open up a building. This system is set to

operate in natural ventilation mode, but if there isn't enough wind to heat, cool, and ventilate a space, it switches to a design building solution.

When the atmospheric condition is excessively unfavourable, the system employs its building's window actuators (which open and shut the windows) and light up the ventilation system. A building with a mixed-mode system can also open and close which improves IAQ with thermal comfort (Lomas, K. J., & Ji, Y., 2009).

Reclaim Public Space

Another feature of a city that will make it more liveable is making it resilient to disease. Due to the design model that is followed in most countries, Jordan included, hallways are essential components of any standard design that is to be arrived at. During the breakout of pandemic disease where the 6ft distancing is encouraged, it is particularly difficult to be implemented in hospital hallways. Even though spaces in new hospital environment on which our 3D models to be illustrated in this study will follow are well managed to accommodate more rooms, there is careful consideration of these measures to limit the spread of disease.

Since the initial lockdown and restriction of movement exercised all around down the world after the initial wave of the deadly pandemic, many businesses were temporarily affected and others still had to deal with extensive disruption. When normalcy was relatively restored and businesses were open again, in order to maintain the recommended social distancing, a lot of people who filled the working class were still poised to adopt remote working routines or to keep in unstable shifts. Unfortunately, for hospitals to function effectively, it may be impossible to engage in these forms of practice.

Analysis of Questionnaire

A survey was conducted and distributed precisely 382 questionnaires to the respondents randomly, which were selected in a Jordanian hospital. The 382 samples selected were calculated from the overall population of Jordan using online internet sample calculator. Jordan 2020 population is estimated at 10,203,134 people at midyear according to UN data (Worldometer, 2022). The questionnaire analysis was divided into 2 groups, i.e. the stakeholders and patients. About 182 respondents, 47.6% of the

participants were people the stakeholders found in the questionnaires distributed. While 200 samples making 52.4% of the respondents were the patients found in the hospital.

The questionnaire in appendix I-III has been designed to determine the assessment of the current conditions in which the pandemic cases are been attended to the available healthcare centres and the suitability of other facilities set aside for the tackling of this novel disease breakout for the Jordan demographics.

The items require your assessment of Antecedent and Transaction variables with regard to the need to put interior hospital process in places within Jordan in a good position to offer necessary healthcare services to the victims of pandemic and prevent any subsequent spread of the disease and other pandemic illnesses.

The frank responses of participants to the items of this questionnaire were used to analyse previous Jordanian hospital and assist in remodelling a new and improved architectural interior structure for the Jordanians.

Questionnaire Analysis of Stakeholders Socio-demographic Data

A. Socio-demographic Data

The data analysis was done using Statistics Program for Social Sciences (SPSS) revealed the nationality, age, gender, occupation, specialisation and in-service result of the participants was present in the table below:

Table 19

Socioeconomic and Demographic Data

Nationality		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Jordanian	148	81.3	81.3	81.3
	Non-Jordanian	34	18.7	18.7	100.0
	Total	182	100.0	100.0	
Age		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18years	13	7.1	7.1	7.1
	19-25years	8	4.4	4.4	11.5
	26-40years	106	58.2	58.2	69.8
	41years and above	55	30.2	30.2	100.0
	Total	182	100.0	100.0	

Gender		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	150	82.4	82.4	82.4
	Female	32	17.6	17.6	100.0
	Total	182	100.0	100.0	
Occupation		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Doctor	78	42.9	42.9	42.9
	Nurse	62	34.1	34.1	76.9
	Attendant	42	23.1	23.1	100.0
	Total	182	100.0	100.0	
Specialization		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Pandemic	68	37.4	37.4	37.4
	Others	114	62.6	62.6	100.0
	Total	182	100.0	100.0	
In-service		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-5years	30	16.5	16.5	16.5
	6-10years	43	23.6	23.6	40.1
	11-20years	71	39.0	39.0	79.1
	21years and above	38	20.9	20.9	100.0
	Total	182	100.0	100.0	

Gender: Demographic results are given in table 4.1 the respondent sample had 182 persons as a stakeholder, 32 females which constitute 17.6% of the total sample and 150 males which corresponds to 82.4% of the sample. This means that male respondents were the majority.

Nationality: The sample had different nationalities, where 81.3% were Jordanian, 18.7% were Non-Jordanian. Here Jordanian nationalities were the main respondents.

Specialization: The sample consisted many stakeholders with different form of specialization, where 68 respondents with pandemic specialization represented 37.4% of the sample and 114 respondents have other forms of health specialization representing 62.6% of the total sample. Though some of the pandemic specialists were much, but those with another specialist were higher.

Age: The sample had different ages, 13 respondents' ages 18 years old, which represented 7.1% of the sample. 8 respondents represented 4.4% of the sample, and their ages ranged between 19-25 years old. Ages of 106 respondents were between 26-40 years old which represented 58.2% of the sample. In addition, ages of 55 respondents were between 41-and above years old which represented 30.2% of the sample. This shows that majority of the respondents' age were 26-40 years of age.

Occupation: The research sample included people from different occupations randomly. There were 78 Doctors which represented 42.9% of the whole sample, 62 Nurse which represent 34.1% of the whole sample, 42 attendant which represented 23.1% of the whole sample.

In-service: Respondents of the sample had different years in service, 30 respondents had 0 to 5 years in-service, which represented 16.5% of total sample. 43 respondents had years in services that ranged between 6-10 years, that represented 23.6 of total sample. 71 respondents had years in service that ranged between 11-20 years, which represented 39.0% of total sample. 38 respondents had years in service that ranged between 21 years and above and that represented 20.9% of total sample.

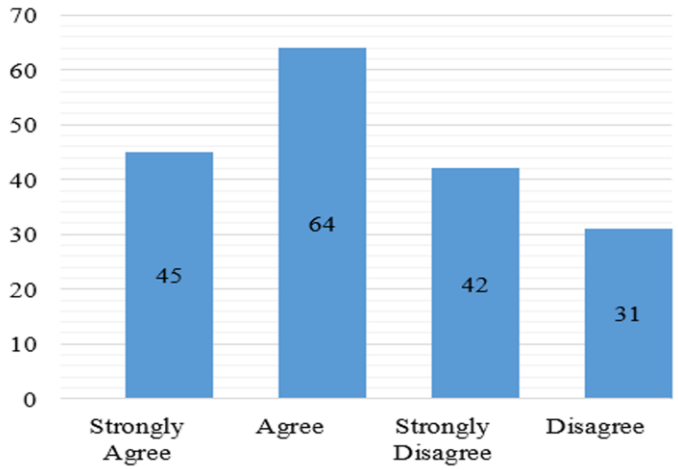
B. Module Hospital Assessment Questionnaire

Hospitals will assist in the fight against pandemic and any other outbreak of diseases. The likert scale: SA = Strongly agree A = Agree D = Disagree SD = Strongly disagree.

Table 20

Hospitals and healthcare facilities available in Jordan are already overstretched in the war against pandemic.

	Frequency	**Percent**
Strongly Agree	45	24.7
Agree	64	35.2
Disagree	42	23.1
Strongly Disagree	31	17.0
Total	182	100.0

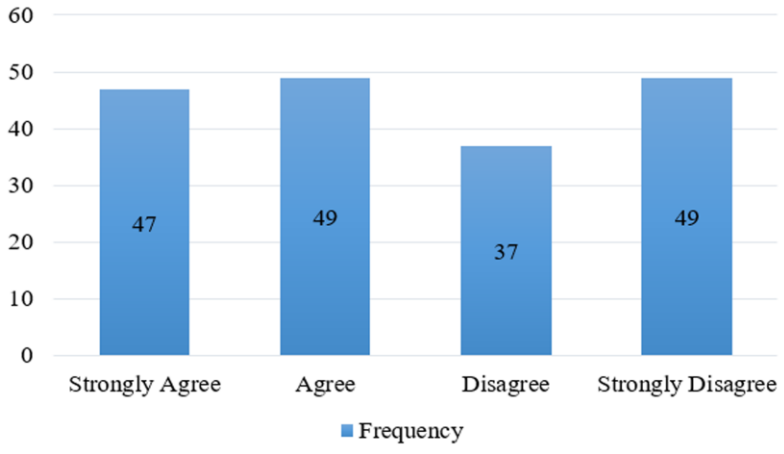


Forty- five (45) respondents strongly agreed that hospitals and healthcare facilities available in Jordan are already overstretched in the war against pandemic, representing 24.7% of the total sample, and 64 respondents agreed, representing 35.2% of the total sample. While 42 respondents disagreed, this represented 23.1% of the total sample, and 31 respondents, that represented 17% of the total sample, strongly disagreed. Therefore, the majority of the respondents agree that all the hospitals in Jordan were overstretched.

Table 21

The government of Jordan has been able to put enough guidelines and safety protocols in place to limit the spread of the virus.

	Frequency	Percent
Strongly Agree	47	25.8
Agree	49	26.9
Disagree	37	20.3
Strongly Disagree	49	26.9
Total	182	100.0

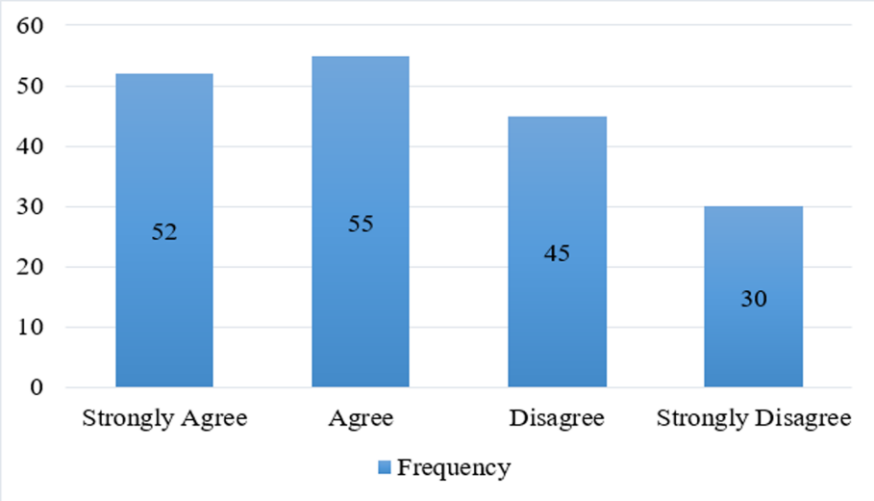


Forty-seven (47) strongly agreed that the Government of Jordan has been able to put enough guidelines and safety protocols in place to limit the spread of the virus and where 49 respondents who represented 26.9% of the total sample agreed. However, 37 respondents disagreed they represented 20.3% of the total sample, in addition, 49 respondents strongly disagreed which represented 26.9% of the total sample. There was a tie in this regard because equal respondents agreed to this question and disagreed at the same time, this might be due to a lack of awareness that makes people not sure of the governmental activities in the country.

Table 22

Module hospitals are extremely important in tackling pandemic.

	Frequency	**Percent**
Strongly Agree	52	28.6
Agree	55	30.2
Disagree	45	24.7
Strongly Disagree	30	16.5
Total	182	100.0

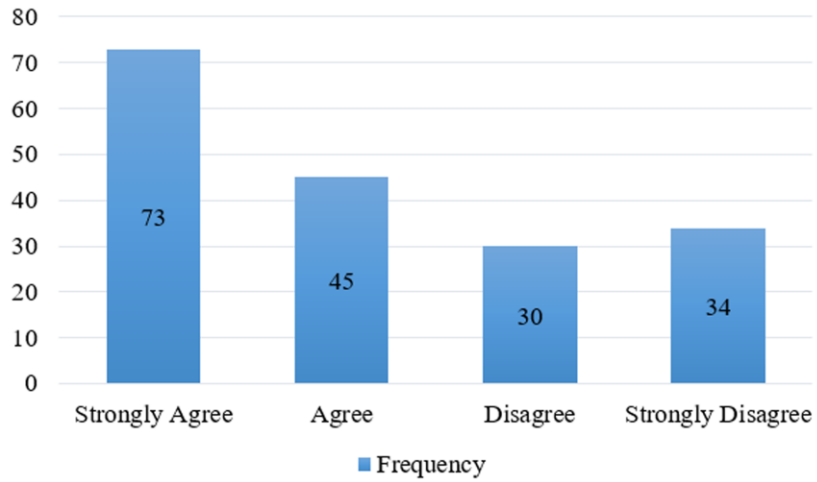


Fifty-two (52) respondents who represented 28.6% of the total sample strongly agreed that the module hospitals are extremely important in tackling pandemic and 55 respondents agreed representing 30.2% of the total sample. However, 45 respondents who represented 24.7% of the total sample disagreed with those who represented 16.5% of the total sample strongly disagreed. The module hospitals were strongly agreed by the majority of the respondents.

Table 23

Module hospitals are good substitute to traditional buildings converted to healthcare centres

	Frequency	Percent
Strongly Agree	73	40.1
Agree	45	24.7
Disagree	30	16.5
Strongly Disagree	34	18.7
Total	182	100.0

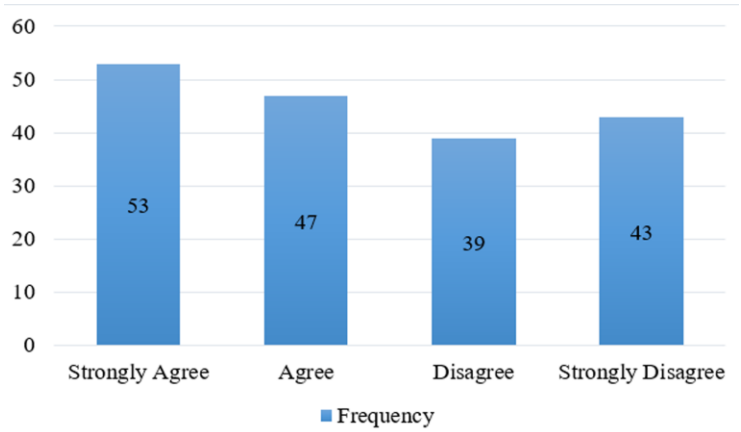


Seventy-three (73) respondents who represented 40.1% of the total sample strongly agreed that module hospitals are a good substitute to traditional buildings converted to healthcare centres, and 45 respondents who represented 24.7% of the total sample agreed While 30 respondents who represented 16.5% of total sample disagreed. Finally, 34 respondents representing 18.7% of the total sample strongly disagreed. Higher responses were given to strongly agree that module hospitals are a good substitute to traditional buildings converted to healthcare centres.

Table 24

Module hospitals require good and improved architectural design

	Frequency	Percent
Strongly Agree	53	29.1
Agree	47	25.8
Disagree	39	21.4
Strongly Disagree	43	23.6
Total	182	100.0

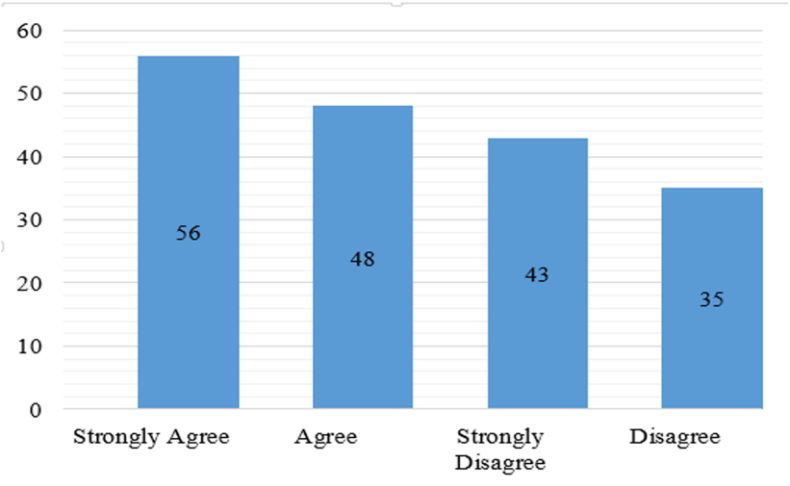


Fifty-three (53) respondents who represented 29.1% of the total sample strongly agreed that the module hospitals require good and improved architectural design, and 47 respondents who represented 25.8% of the total sample agreed. However, four-seven respondents who represented 21.4% of the total sample disagreed, in addition, 43 respondents which represented 23.9% of the total sample strongly disagreed. The majority of the respondents strongly agreed that Module Hospitals require good and Improved Architectural Design.

Table 25

There is no functioning module hospital in Jordan

	Frequency	Percent	Cumulative Percent
Strongly Agree	56	30.8	30.8
Agree	48	26.4	57.1
Disagree	43	23.6	80.8
Strongly Disagree	35	19.2	100.0
Total	182	100.0	

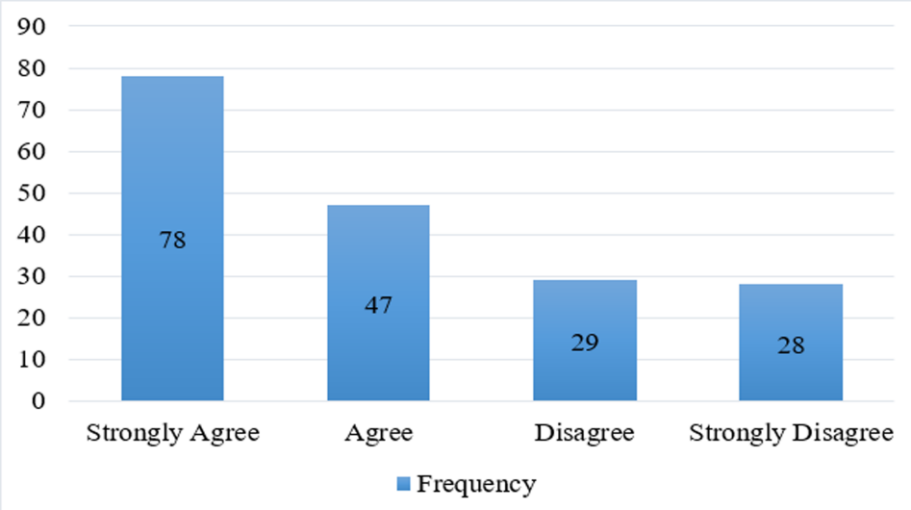


Fifty-six (56) respondents who represented 30.8% of the total sample strongly agreed that there is no functioning module hospital in Jordan, in addition, 48 respondents who represented 26.4% of the total sample agreed. However, 43 respondents representing 23.6% of the total sample disagreed and 35 respondents representing 19.2% of the total sample strongly disagreed. Most of the respondents strongly agreed that there is no functioning module hospital in Jordan.

Table 26

Hotels and residential buildings should effectively be replaced by module hospitals in the fight against pandemic or any other eventual pandemic situation

	Frequency	Percent
Strongly Agree	78	42.9
Agree	47	25.8
Disagree	29	15.9
Strongly Disagree	28	15.4
Total	182	100.0

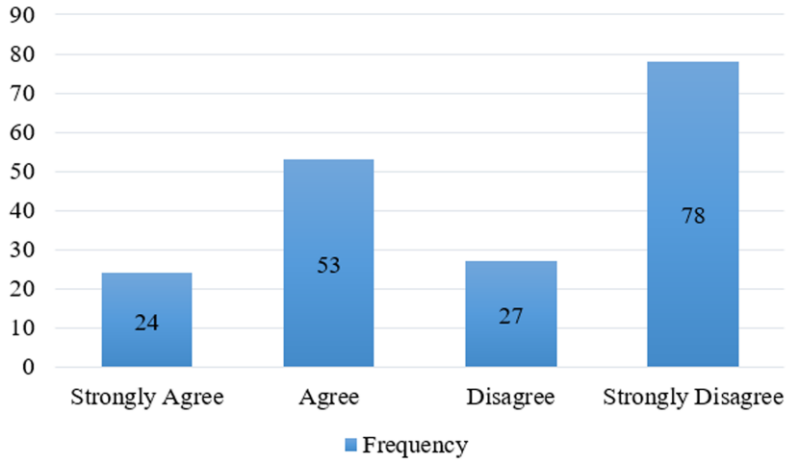


Seventy-eight (78) respondents 42.9% of the total sample strongly agreed that hotels and residential buildings should effectively be replaced by module hospitals in the fight against pandemic, and 47 respondents who represented 25.8% of the total sample agreed. However, 29 respondents who represented 15.9% of the total sample disagreed, and 28 respondents who represented 15.4% of the total sample strongly disagreed. The majority of the respondents strongly agree that hotels and residential buildings should effectively be replaced by module hospitals in the fight against any other eventual pandemic situation.

Table 27

The conversion of buildings and structures of other use to pandemic quarantine centres is the right move in the right direction

	Frequency	Percent
Strongly Agree	24	13.2
Agree	53	29.1
Disagree	27	14.8
Strongly Disagree	78	42.9
Total	182	100.0

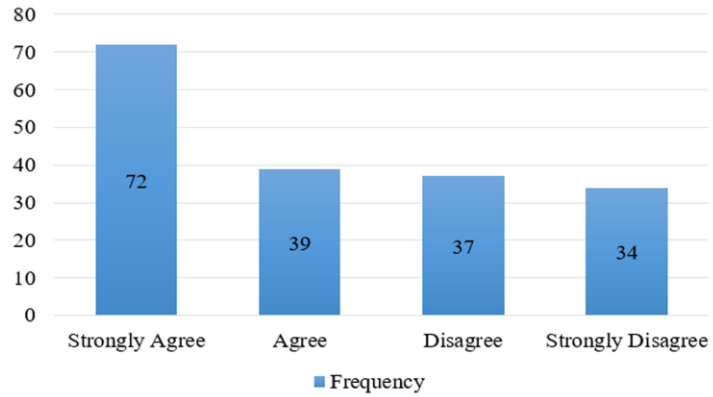


Seventy-eight (78) respondents representing 42.9% of the total sample strongly agreed that the conversion of buildings and structures of other use to pandemic quarantine centres is the right move in the right direction, and 53 respondents who represented 29.1% of the total sample agreed. However, 27 respondents who represented 14.8% of the total sample disagreed and 24 respondents who represented 13.2% of the total sample strongly disagreed. There are higher responses of the participants who strongly disagreed that the conversion of buildings and structures of other use to pandemic quarantine centres is the right move in the right direction.

Table 28

The conversion of buildings and structures of other use to pandemic quarantine centres is the wrong move in the right direction

	Frequency	**Percent**
Strongly Agree	72	39.6
Agree	39	21.4
Disagree	37	20.3
Strongly Disagree	34	18.7
Total	182	100.0

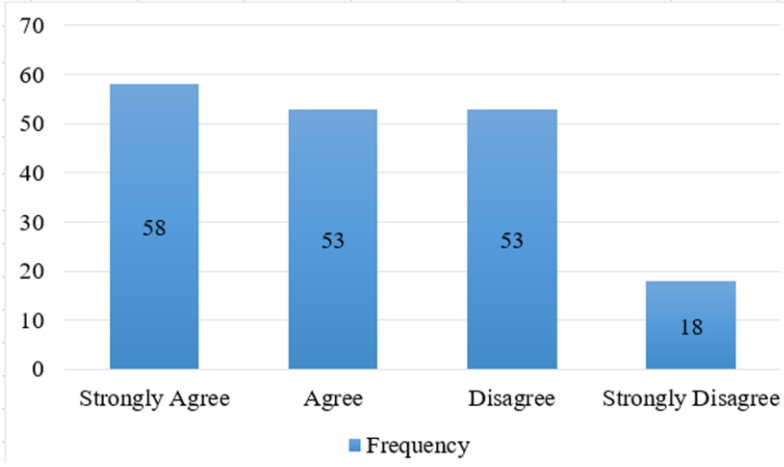


Seventy-two (72) respondents representing 39.6% of the total sample strongly agreed that the conversion of buildings and structures of other use to pandemic quarantine centres is the wrong move in the right direction, and 39 respondents who represented nearly 21.4 % of the total sample agreed. In addition, 37 respondents who represented 20.3% of the total sample disagreed. However, 34 respondents represented 18.7% of the total sample. Here, the majority of the respondents strongly disagreed that the conversion of buildings and structures of other use to pandemic quarantine centres are the wrong move in the right direction.

Table 29

The conversion of buildings and structures of other use to pandemic quarantine centres is the right move in the wrong direction

	Frequency	Percent	Cumulative Percent
Strongly Agree	58	31.9	31.9
Agree	53	29.1	61.0
Disagree	53	29.1	90.1
Strongly Disagree	18	9.9	100.0
Total	182	100.0	

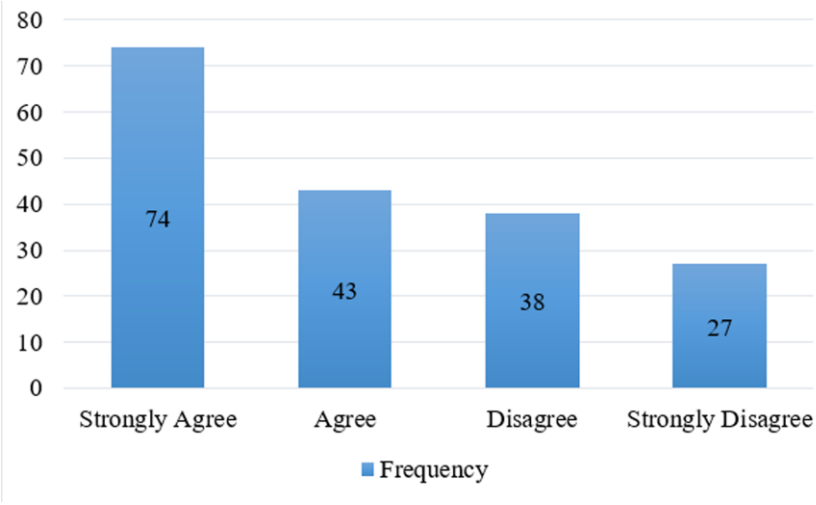


58 respondents representing 31.9% of the total sample strongly agreed that the conversion of buildings and structures of other use to pandemic quarantine centres is the right move in the wrong direction, and 53 respondents who represented 29.1% of the total sample agreed. However, 53 respondents who represented 29.1% of the total sample disagreed, and 18 respondents who represented 9.9% strongly disagreed. A higher population sample strongly disagreed that the conversion of buildings and structures of other use to pandemic quarantine centres are the right move in the wrong direction.

Table 30

Jordan is winning the war against pandemic infection

	Frequency	**Percent**
Strongly Agree	74	40.7
Agree	43	23.6
Disagree	38	20.9
Strongly Disagree	27	14.8
Total	182	100.0



Seventy-four (74) respondents who represented 40.7% of the total sample strongly agreed that Jordan is winning the war against pandemic infection, and 43 respondents who represented 20.9% of the total sample agreed. 38 respondents who represented 20.9% of the total sample disagree. Finally, 27 respondents who represented 14.8% of the total sample strongly disagreed. Therefore, the majority of the respondent strongly agrees that Jordan is winning the war against the current pandemic.

C. Basic Interest Expression in the Implementation of Module Hospital Questionnaire

Table 31

The available healthcare centres are sufficient enough to afford quarantine services to patients of pandemic.

	Frequency	Percent
Yes	90	49.5
No	92	50.5
Total	182	100.0

Ninety-two (90) respondents representing 49.5% of the total sample implied yes that the available healthcare centres are sufficient enough to afford quarantine services to patients of pandemic, and 92 respondents who represented 50.5% of the total sample did not agree. The respondents say the available healthcare centres are not sufficient enough to afford quarantine services for patients with pandemic.

Table 32

Healthcare centres are well staffed to attend to prospective pandemic patients.

	Frequency	Percent
Yes	80	44.0
No	102	56.0
Total	182	100.0

Eighty (80) respondents who represented 44% of the total sample agreed that the healthcare centres are well staffed to attend to prospective pandemic patients, and 102 respondents who represented 56.0% of the total sample did not agree. Therefore, there are no adequate healthcare centre staffs to attend to prospective pandemic patients.

Table 33

There are enough health facilities in health centres in Jordan.

	Frequency	Percent
Yes	83	45.6
No	99	54.4
Total	182	100.0

Eighty-three (83) respondents who represented 45.6% of the total sample agreed that there are enough health facilities in health centres in Jordan, and 99 respondents who represented 54.4% of the total sample did not agree. There are not enough health facilities in health centres in Jordan, the majority of the respondents say.

Table 34

The number of recorded cases in Jordan is rising since the breakout of the infection.

	Frequency	Percent
Yes	104	57.1
No	78	42.9
Total	182	100.0

One hundred and four (104) respondents who represented 57.1% of the total sample agreed that the number of recorded cases in Jordan is rising since the breakout of the infection, and 42.9% of the total sample which corresponded to 78 respondents disagreed with it. The case on number of recorded pandemic cases in Jordan has been rising since the breakout of the infection.

Table 35

Victim pandemic that has been admitted into the hospital has been known to adhere strictly to precautions against the spread of the virus.

	Frequency	Percent
Yes	63	34.6
No	119	65.4
Total	182	100.0

63 respondents who represented 34.6% of the total sample agreed that the victims of pandemic that have been admitted into the hospital have been known to adhere strictly to precautions against the spread of the virus, and 119 respondents who represented 65.4% of the total sample agreed. Therefore, the victims of pandemic that have been admitted into the hospital have not been known to adhere strictly to precautions against the spread of the virus.

Table 36

Healthcare workers are well protected against the eventuality of contracting the Virus.

	Frequency	Percent
Yes	83	45.6
No	99	54.4
Total	182	100.0

83 respondents who represented 45.6% of the total sample agreed that healthcare workers are well protected against the eventuality of contracting the virus, and 99 respondents who represented 54.4% of the total sample did not agree. A high response was given to the statement that Healthcare workers are not well protected against the eventuality of contracting the virus.

Table 37

Doctors stand more chances of contracting pandemic when attending to patient.

	Frequency	Percent
Yes	113	62.1
No	69	37.9
Total	182	100.0

One hundred and thirteen (113) respondents who represented 62.1% of the total sample agreed that Doctors stand more chances of contracting pandemic when attending to patients, and 69 respondents who represented 37.9% of the total sample do not agree. Therefore, the research calls doctors to be extra careful when attending to communicable diseases like pandemic patients to alleviate the spread.

Table 38

Nurses sand more chances of contracting pandemic when attending to patients.

	Frequency	Percent
Yes	112	61.5
No	70	38.5
Total	182	100.0

One hundred and twelve (112) respondents who represented 61.5% of the total sample agreed that Nurses stand more chances of contracting pandemic when attending to patients. However, 70 respondents represented 38.5% of the total sample who disagreed. However, the respondents say Nurses stand more chances of contracting pandemic when attending to patients.

Table 39

Patients respond well to treatments in modified hospitals.

	Frequency	Percent
Yes	75	41.2
No	107	58.8
Total	182	100.0

75 respondents who represented 41.2% of the total sample agreed that Patients respond well to treatments in modified hospitals, in addition, 107 respondents who represented 58.8% of the total sample do not agree. Therefore, patients do not respond well to treatments in modified hospitals.

Table 40

Government should stick to the conversion of hotels and residential buildings to pandemic emergency centres.

	Frequency	Percent
Yes	85	46.7
No	97	53.3
Total	182	100.0

46.7% of the total sample which corresponded to 85 respondents out of the 182 respondents agreed that government should stick to the conversion of hotels and residential buildings to pandemic emergency centres, in addition, 97 respondents who represented 53% of the total sample did not agree. Therefore, the majority of the people do not think that the government should stick to the conversion of hotels and residential buildings to pandemic emergency centres.

Table 41

Government should prioritize funding and expanding already existing hospitals instead of initiating the idea of module hospitals.

	Frequency	Percent
Yes	100	54.9
No	82	45.1
Total	182	100.0

Hundred (Of 100) respondents 54.9% of the total sample strongly agreed that the Government should prioritize funding and expanding already existing hospitals instead of initiating the idea of module hospitals, and 82 respondents represented 45.1% of the total sample did not agree that the Government should prioritize funding and expanding already existing hospitals instead of initiating the idea of module hospitals.

Table 41

Module hospitals will damage the integrity of existing hospitals in the fight against any unforeseen Pandemic disease.

	Frequency	Percent
Yes	78	42.9
No	104	57.1
Total	182	100.0

78 respondents who represented 42.9% of the total sample agreed on module hospitals will damage the integrity of existing hospitals in the fight against any unforeseen pandemic disease, and 104 respondents who represented 57.1% of the total

sample did not agree. The respondents majorly say the Module hospitals will not damage the integrity of existing hospitals in the fight against any unforeseen pandemic disease.

Table 42

To ensure effectiveness in healthcare services delivery, module hospitals should be an initiative of private institutions rather than the government.

	Frequency	Percent
Yes	96	52.7
No	86	47.3
Total	182	100.0

Ninety-six (96) respondents 52.7% of the total sample agreed to ensure effectiveness in healthcare services delivery, module hospitals should be an initiative of private institutions rather than the government, and 86 respondents representing nearly 47.3 % of the total sample do not agree. Most of the respondents agree to ensure effectiveness in healthcare services delivery, module hospitals should be an initiative of private institutions rather than the government.

Table 43

I will rather visit a traditional hospital than a module hospital when the need arise.

		Frequency	Percent	Cumulative Percent
Valid	Yes	92	50.5	50.5
	No	90	49.5	100.0
	Total	182	100.0	

92 respondents representing 50.5% of the total sample agreed that they would rather visit a traditional hospital than a module hospital when the need arises, and 90 respondents who represented 49.5% of the total sample did not agree.

Table 44

If well designed and implemented, I think the module hospital will be a good idea in successfully ensuring a lasting solution to the unforeseen outbreak of diseases.

		Frequency	Percent	Cumulative Percent
Valid	Yes	106	58.2	58.2
	No	76	41.8	100.0
	Total	182	100.0	

One hundred and six (106) respondents who represented 58.2% of the total sample agreed that if well designed and implemented and 76 respondents who represented 41.8% of the total sample did not agree. The majority of the participants say if well

designed and implemented, I think the module hospital will be a good idea in successfully ensuring a lasting solution to the unforeseen outbreak of diseases.

Questionnaire Analysis of the Patients

a. Socio-demographic Data Analysis

Here the respondents were asked about their social status, while at same time trying to hide their sensitive personal information and making them anonymous. These social statuses were common questions asked in many questionnaires, e.g. age, gender, residence, nationality, occupation etc.

Table 45

The Socioeconomic Data

		Frequency	Percent	Valid Percent	Cumulative Percent
Residence	Jordan	179	89.5	89.5	89.5
	Outside Jordan	21	10.5	10.5	100.0
	Total	200	100.0	100.0	
Nationality	Jordan	181	90.5	90.5	90.5
	Non-Jordan	19	9.5	9.5	100.0
	Total	200	100.0	100.0	
Age	Under18	20	10.0	10.0	10.0
	19-25yrs	18	9.0	9.0	19.0
	26-40yrs	37	18.5	18.5	37.5
	41yrs & above	125	62.5	62.5	100.0
	Total	200	100.0	100.0	
Gender	Male	160	80.0	80.0	80.0
	Female	40	20.0	20.0	100.0
	Total	200	100.0	100.0	
Occupation	Student	54	27.0	27.0	27.0
	Arstisan	56	28.0	28.0	55.0
	Civil Servant	70	35.0	35.0	90.0
	Hospital Staff	20	10.0	10.0	100.0
	Total	200	100.0	100.0	
Nature of Sickness	Pandemic	173	86.5	86.5	86.5
	Other	27	13.5	13.5	100.0
	Total	200	100.0	100.0	

All the demographic results are given in table 4.27. The respondent sample for the patients had 200 persons.

Nationality: About 179 of the respondents living in Jordan are Jordanian which constitute 89.5% of the total sample and 21 of the respondents residing in Jordan are Non-Jordanian which corresponds to 10.5% of the sample. The sample had different nationalities with 181 are nationals of Jordan that accounts for 90.5% of the respondents and then 19 of the respondents are not nationals of Jordan and these categories represents 9.5% of the respondents.

Age: The age category of the respondents comprise 20 respondents that is 10% of the total respondents are under the 18 years of age, 18 representing 9% of the respondents are those under the age of 19 – 25 years, 37 of the respondents are 18.5% of the total respondents that are between the age of 26 to 40 years of age, 125 of the respondents that is 62.5% are those in the category of 41 and above years of age.

Gender: Regarding the gender of the respondents 40 are females which constitute 20% of the total sample and 160 are males which corresponds to 80% of the sample.

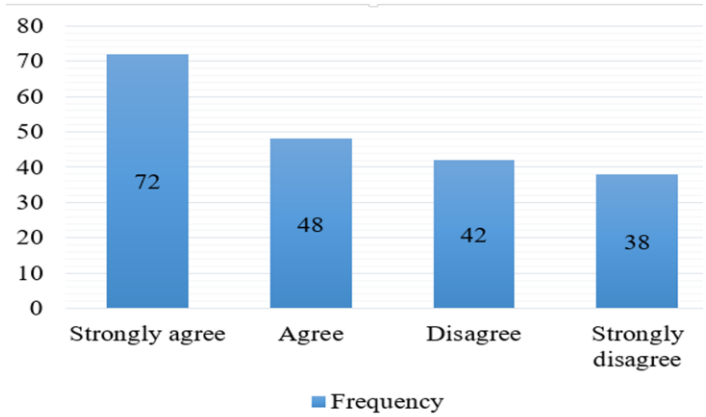
Occupation: As for the occupation of the respondents 27% of 54 are students, 28% of 56 are Artisans, 35% of 70 are civil servants and 10% of 20 are hospital staffs. The respondents are patients, for the nature of their sickness 173 of 86.5% are pandemic patients, 27 of 13.5% of the patients have other forms of sickness.

B. Module Hospital Assessment Questionnaire

Table 46

Hospitals and healthcare facilities available in Jordan are already overstretched in the war against pandemic

Scale	Frequency	Percent
Strongly agree	72	36.0
Agree	48	24.0
Disagree	42	21.0
Strongly disagree	38	19.0
Total	200	100.0

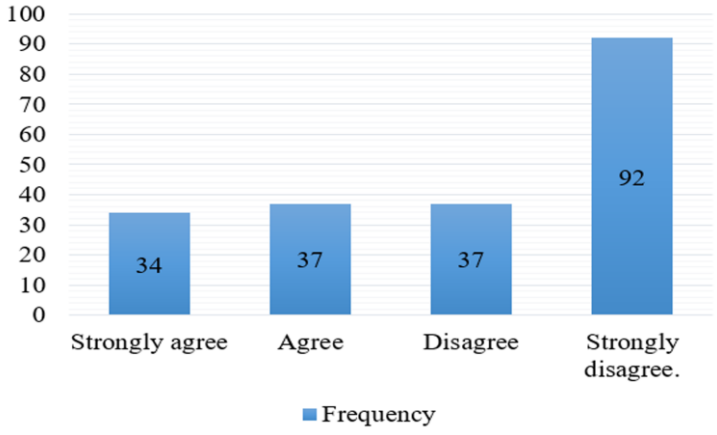


A higher response of (72) 36% of the respondents strongly agreed that hospitals and healthcare facilities available in Jordan are already overstretched in the war against pandemic representing 19.0% of the total sample, 48 respondents agreed that hospitals and healthcare facilities available in Jordan are already overstretched in the war against pandemic that represented 24.0% of the total sample. 42 respondents disagreed representing 21% of the total sample and while 38 (19%) respondents strongly agreed representing 36% of the total sample. Therefore, hospitals and healthcare facilities available in Jordan are already overstretched in the war against pandemic.

Table 47

The government of Jordan has been able to put enough guidelines and safety protocols in place to limit the spread of the virus

	Frequency	Percent
Strongly agree	34	17.0
Agree	37	18.5
Disagree	37	18.5
Strongly disagree.	92	46.0
Total	200	100.0

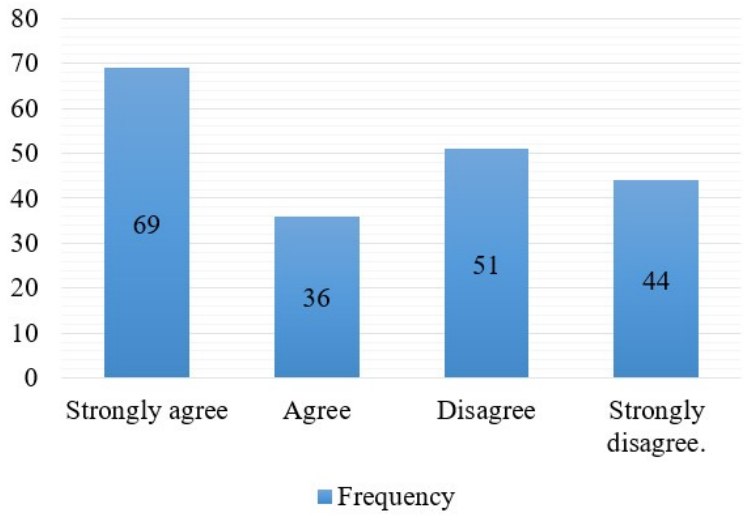


Thirty-four (34) strongly agreed on the fact that the government of Jordan has been able to put enough guidelines and safety protocols in place to limit the spread of the virus representing 17% of the total sample. 37 respondents who represented 18.5% of the total sample agreed. However, 37 respondents disagreed they represented 18.5% of the total sample; in addition, 92 respondents strongly disagreed with this statement. However, the government of Jordan did not put enough guidelines and safety protocols in place to limit the spread of the virus which represented 46% of the total sample.

Table 48

Module hospitals are extremely important in tackling pandemic

		Frequency	Percent
Valid	Strongly agree	69	34.5
	Agree	36	18.0
	Disagree	51	25.5
	Strongly disagree.	44	22.0
	Total	200	100.0

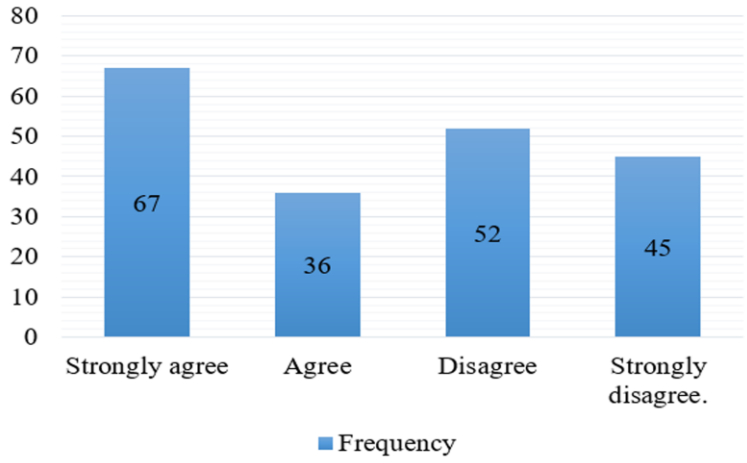


69 respondents who represented 34.5% of the total sample strongly agreed that the module hospitals are extremely important in tackling pandemic. 36 respondents agreed representing 18% of the total sample. However, 51 respondents who represented 25.5% of the total sample disagreed, and 44 respondents who represented 22% of the total sample strongly disagreed. Therefore, module hospitals are extremely important in tackling the pandemic virus.

Table 49

Module hospitals are good substitute to traditional buildings converted to healthcare centres

		Frequency	Percent
	Strongly agree	67	33.5
	Agree	36	18.0
	Disagree	52	26.0
	Strongly disagree.	45	22.5
	Total	200	100.0

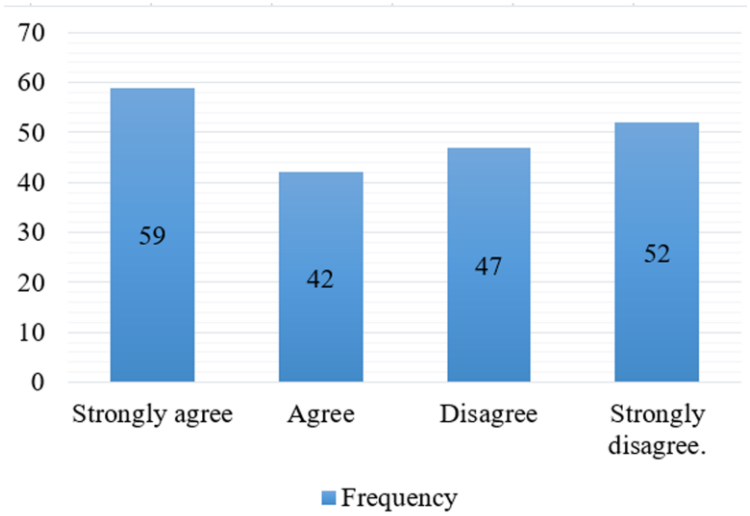


67 respondents who represented 33.5% of the total sample strongly agreed that module hospitals are a good substitute for traditional buildings converted to healthcare centres, 36 respondents who represented 18% of the total sample agreed, and 52 respondents who represented 26% of the total sample disagreed. Finally, 45 respondents representing 22.5% of the total sample strongly disagreed. Therefore, it was strongly agreed that module hospitals are a good substitute to traditional buildings converted to healthcare centres.

Table 50

Module hospitals require good and improved architectural design

		Frequency	Percent
Valid	Strongly agree	59	29.5
	Agree	42	21.0
	Disagree	47	23.5
	Strongly disagree.	52	26.0
	Total	200	100.0

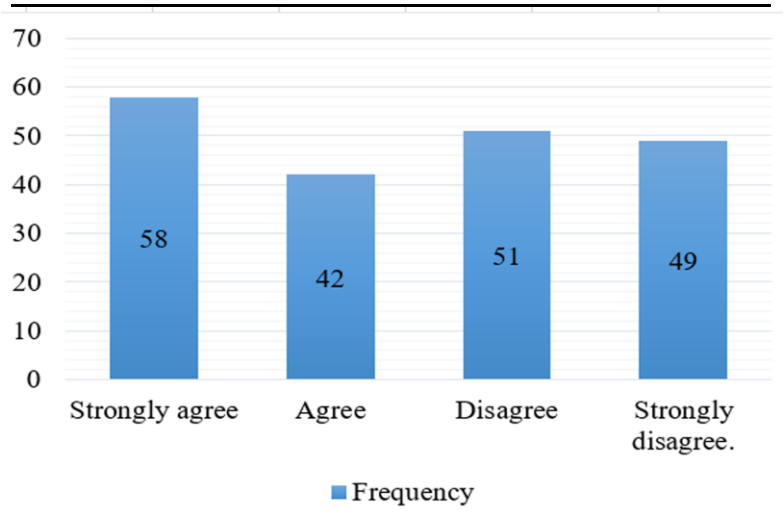


Out of 200, 59 respondents who represented 29.5% of the total sample strongly agreed that module hospitals require good and improved architectural design. 42 respondents who represented 21% of the total sample agreed. However, 51 respondents who represented 25.5% of the total sample disagreed, and 58 respondents representing 29% of the sample strongly disagreed. This means that the Module hospitals require good and improved architectural design.

Table 51

There is no functioning module hospital in Jordan

	Frequency	Percent
Strongly agree	58	29.0
Agree	42	21.0
Disagree	51	25.5
Strongly disagree.	49	24.5
Total	200	100.0

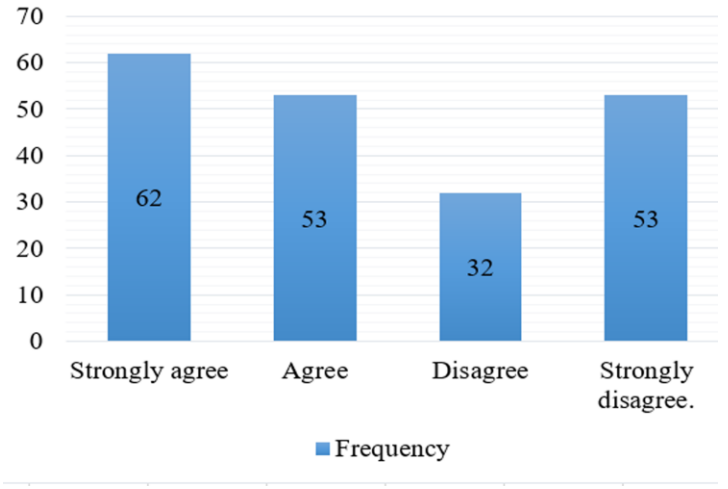


58 respondents who represented 29.0% of the total sample strongly agreed that there is no functioning module hospital in Jordan, and 42 respondents who represented 21% of the total sample agreed. However, 51 respondents who represented 25.5% of the total sample disagreed, in addition, 49 respondents who represented 24.5% of the total sample strongly disagreed. Therefore, there is no functioning module hospital in Jordan.

Table 52

Hotels and residential buildings should effectively be replaced by module hospitals in the fight against pandemic or any other eventual pandemic situation.

	Frequency	Percent
Strongly agree	62	31.0
Agree	53	26.5
Disagree	32	16.0
Strongly disagree.	53	26.5
Total	200	100.0

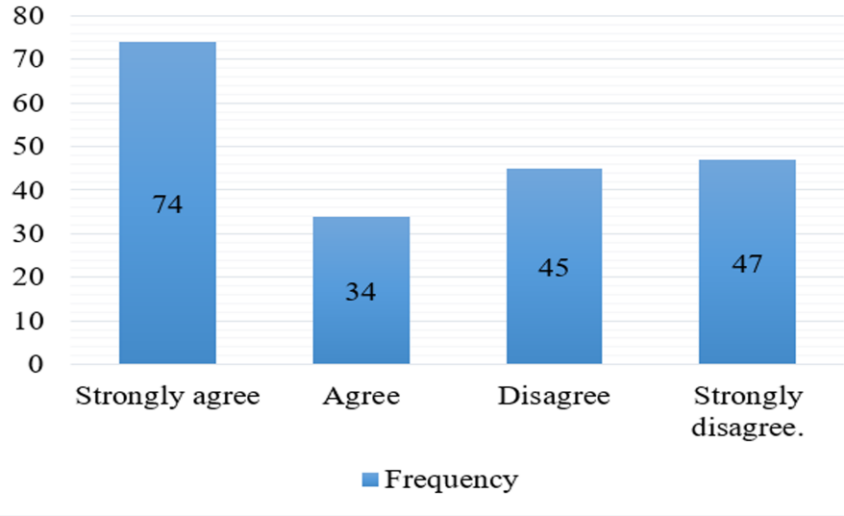


62 respondents who represented 31% of the total sample strongly agreed on that the Hotels and residential buildings should effectively be replaced by module hospitals in the fight against pandemic or any other eventual pandemic situation, and 53 respondents who represented 26.5% of the total sample agreed. In addition, 32 respondents who represented 16% of the total sample were disagreed, and 53 respondents who represented 26.5% of the total sample strongly disagreed. Therefore, hotels and residential buildings should effectively be replaced by module hospitals in the fight against pandemic or any other eventual pandemic situation.

Table 53

The conversion of buildings and structures of other use to pandemic quarantine centres is the right move in the right direction

	Frequency	Percent
Strongly agree	74	37.0
Agree	34	17.0
Disagree	45	22.5
Strongly disagree.	47	23.5
Total	200	100.0

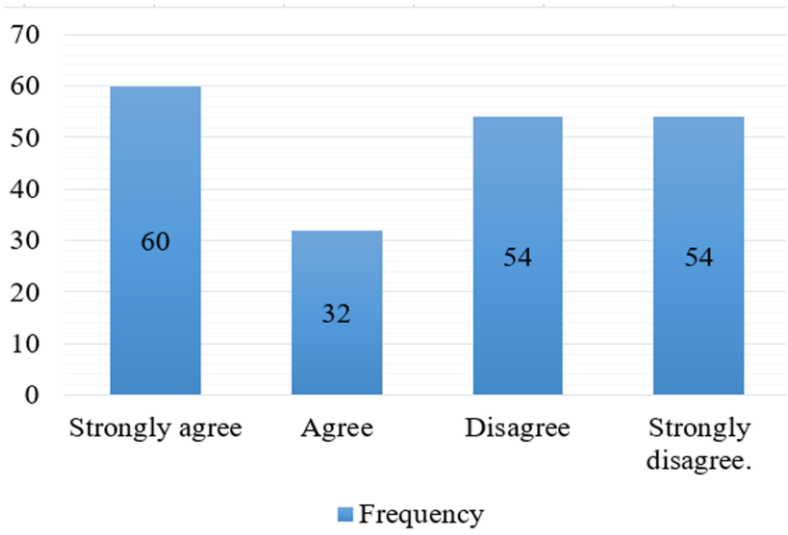


74 respondents who represented 37% of the total sample strongly agreed that the conversion of buildings and structures of other use to pandemic quarantine centres is the right move in the right direction, in addition, 34 respondents who represented 17% of the total sample agreed. However, 45 respondents representing 23.5% of the total sample disagreed and 47 respondents strongly disagreed.

Table 54

The conversion of buildings and structures of other use to pandemic quarantine centres is the wrong move in the right direction.

	Frequency	Percent
Strongly agree	60	30.0
Agree	32	16.0
Disagree	54	27.0
Strongly disagree.	54	27.0
Total	200	100.0



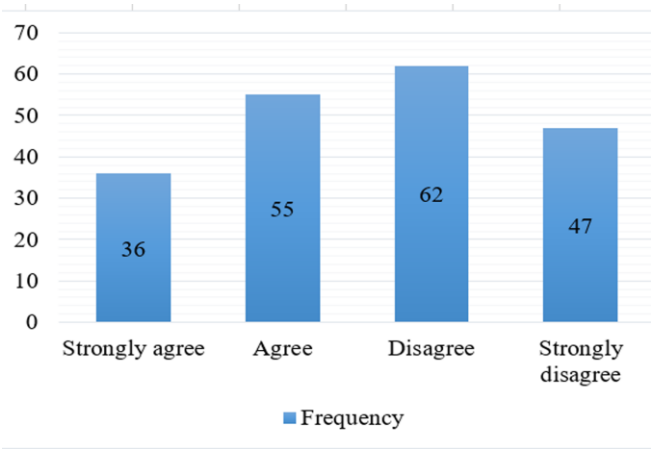
30% of the total sample which corresponded to 60 respondents out of the 200 respondents, strongly agreed that the conversion of buildings and structures of other use to pandemic quarantine centres is the wrong move in the right direction, in addition, 32 respondents represented 16% of the total sample agreed on the conversion of buildings and structures of other use to pandemic quarantine centres is the wrong move in the right direction.

However, 54 respondents who represented 27% of the total sample disagreed that the conversion of buildings and structures of other use to pandemic quarantine centres is the wrong move in the right direction, and 54 respondents who represented 27% of the total sample strongly disagreed. Therefore, the conversion of buildings and structures of other use to pandemic quarantine centres is the wrong move in the right direction.

Table 55

The conversion of buildings and structures of other use to pandemic quarantine centres is the right move in the wrong direction.

	Frequency	Percent
Strongly agree	36	18.0
Agree	55	27.5
Disagree	62	31.0
Strongly disagree	47	23.5
Total	200	100.0

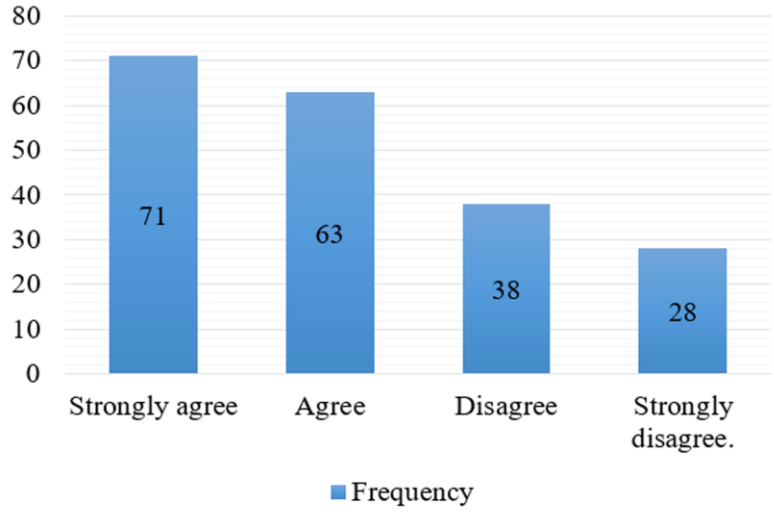


Thirty-six (36) respondents who represented 18% of the total sample strongly agreed that the conversion of buildings and structures of other use to pandemic quarantine centres is the right move in the wrong direction, and 55 respondents who represented 27.5% of the total sample agreed. However, 62 respondents who represented 31% of the total sample disagreed, and 47 respondents who represented 23.5% of the total sample strongly disagreed. Therefore, the conversion of buildings and structures of other use to pandemic quarantine centres is the right move in the wrong direction.

Table 56

Jordan is winning the war against pandemic infection

	Frequency	Percent
Strongly agree	71	35.5
Agree	63	31.5
Disagree	38	19.0
Strongly disagree.	28	14.0
Total	200	100.0



Seventy-one (71) respondents representing 35.5% of the total sample strongly agreed that Jordan is winning the war against pandemic infection, and 63 respondents representing 31.5% of the total sample agreed. However, 38 respondents representing 19% of the total sample disagreed, and 28 respondents representing 14% of the total sample strongly disagreed. Therefore, Jordan is winning the war against pandemic infection.

C. Basic interest expression in the implementation of module hospital questionnaire

Out of 200, 111 respondents representing 55.5% of the total sample are on the opinion that the available healthcare centres are sufficient enough to afford quarantine services to patients of pandemic while 89 respondents representing 44.5% of the total sample agreed.

Table 57

The available healthcare centres in sufficient enough to afford quarantine services to patients of pandemic.

	Frequency	Percent
Yes	89	44.5
No	111	55.5
Total	200	100.0

Table 58

Healthcare centres are well staffed to attend to prospective pandemic patients

	Frequency	Percent
Yes	94	47.0
No	106	53.0
Total	200	100.0

Ninety-four (94) respondents who represented 47% of the total sample agreed with the assertion that Healthcare centres are well staffed to attend to prospective pandemic patients while 106 respondents who represented 53% of the total sample said no.

Table 59

There are enough health facilities in health centres in Jordan.

	Frequency	Percent
Yes	95	47.5
No	105	52.5
Total	200	100.0

95 respondents who represented 47.5% of the total sample said yes that there are enough health facilities in health centres in Jordan while 105 respondents who represented 52.5% of the total sample said no.

Table 60

The number of recorded cases in Jordan is rising since the breakout of the infection.

	Frequency	Percent
Yes	116	58.0
No	84	42.0
Total	200	100.0

One hundred and sixteen (116) respondents who represented 58% of the total sample are on the opinion that the number of recorded cases in Jordan are rising since the breakout of the infection while 84 respondents that are equivalent to 42% of the respondents say no. The respondents who are on the opinion that the number of recorded cases in Jordan are rising since the breakout of the infection are more than those who say no.

Table 61

Victims pandemic that has been admitted into the hospital has been known to adhere strictly to precautions against the spread of the virus.

	Frequency	Percent
Yes	109	54.5
No	91	45.5
Total	200	100.0

One hundred and nine (109) respondents who represented 54.5% of the total sample say yes that Victims of pandemic who have been admitted to the hospital have been known to adhere strictly to precautions against the spread of the virus. In addition, 91 respondents who represented 45.5% of the total sample said no and did not agree with the statement. Therefore, victims of pandemic who have been admitted to the hospital have been known to adhere strictly to precautions against the spread of the virus.

Table 62

Healthcare workers are well protected against the eventuality of contracting the virus.

	Frequency	Percent
Yes	72	36.0
No	128	64.0
Total	200	100.0

72 respondents who represented 36% of the whole sample say yes and strongly agreed with the statement that Healthcare workers are well protected against the eventuality of contracting the virus while 128 respondents representing 64% of the total sample said no and did not agree. Therefore, healthcare workers are not well protected against the eventuality of contracting the virus.

Table 63

Doctors stand more chances of contracting pandemic when attending to patient.

	Frequency	Percent
Yes	110	55.0
No	90	45.0
Total	200	100.0

One hundred and ten (110) respondents who represented 55% of the total sample were on the opinion that Doctors stand more chances of contracting pandemic when attending to patients. However, ninety respondents represented 45% of the total sample who disagreed with this assertion. Therefore, doctors stand more chances of contracting pandemic when attending to patients.

Table 64

Nurses stand more chances of contracting pandemic when attending to patients

	Frequency	Percent
Yes	104	52.0
No	96	48.0
Total	200	100.0

52% of the total sample which corresponded to 104 respondents were in support of the point that nurses stand more chances of contracting pandemic when attending to patients. However, 96 respondents who represented 48% of the total sample disagreed with the statement.

Table 65

Patients respond well to treatments in modified hospitals

	Frequency	Percent
Yes	93	46.5
No	107	53.5
Total	200	100.0

Ninety-three (93) respondents representing 46.5% of the total sample said yes to a statement that patients respond well to treatments in modified hospitals, and 107

respondents representing 53.5% of the total sample did not agree, which was the majority response received.

Table 66

Government should stick to the conversion of hotels and residential buildings to pandemic emergency centres

	Frequency	Percent
Yes	95	47.5
No	105	52.5
Total	200	100.0

95 respondents who represented 47.5% of the total sample strongly agreed on the fact that the government should stick to the conversion of hotels and residential buildings to pandemic emergency centres. In addition, 105 respondents who represented 52.5% of the total sample do not agree.

Table 67

Government should prioritize funding and expanding already existing hospitals instead of initiating the idea of module hospitals.

	Frequency	Percent
Yes	95	47.5
No	105	52.5
Total	200	100.0

Ninety-five (95) respondents who represented 47.5% of the total sample strongly agreed that the government should prioritize funding and expanding already existing hospitals instead of initiating the idea of module hospitals, and 105 respondents who represented 52.5% of the total sample disagreed. Therefore, the government should not prioritize funding and expanding already existing hospitals instead of initiating the idea of module hospitals.

Table 68

Module hospitals will damage the integrity of existing hospitals in the fight against any unforeseen pandemic disease.

	Frequency	Percent
Yes	97	48.5
No	103	51.5
Total	200	100.0

97 respondents who represented 48.5% of the total sample strongly agreed that the module hospitals will damage the integrity of existing hospitals in the fight against any unforeseen pandemic disease, and 103 respondents who represented nearly 51.5 % of the total sample do not agree. Therefore, Module hospitals will not damage the integrity of existing hospitals in the fight against any unforeseen pandemic disease.

Table 69

To ensure effectiveness in healthcare service delivery, module hospitals should be an initiative of private institutions rather than the government.

	Frequency	Percent
Yes	87	43.5
No	113	56.5
Total	200	100.0

87 respondents representing 43.5% of the total sample strongly agreed by saying yes to ensure effectiveness in healthcare services delivery, module hospitals should be an initiative of private institutions rather than the government, and 113 respondents who represented 56.5% of the total sample do not agree by saying no. Therefore, to ensure effectiveness in healthcare services delivery, module hospitals should not be an initiative of private institutions rather than the government.

Table 70

I will rather visit a traditional hospital than a module hospital when the need arises.

	Frequency	Percent
Yes	98	49.0
No	102	51.0
Total	200	100.0

Ninety-eight (98) respondents who represented 49% of total sample will rather visit a traditional hospital than a module hospital when the need arises, and 102 respondents who represented 51% of total sample will rather not. Therefore, the respondent will prefer to visit a traditional hospital than a module hospital when the need arises.

Table 71

If well designed and implemented, I think the module hospital will be a good idea in successfully ensuring a lasting solution to the unforeseen outbreak of diseases.

	Frequency	Percent
Yes	131	65.5
No	69	34.5
Total	200	100.0

There were 131 respondents who represented 65.5% of total sample strongly agreed on that If well designed and implemented, I think the module hospital will be a good idea in successfully ensuring a lasting solution to the unforeseen outbreak of diseases, and 69 respondents who represented 34.5% of total sample do not agreed on if well designed and implemented, I think the module hospital will be a good idea in successfully ensuring a lasting solution to the unforeseen outbreak of diseases. The majority of the respondent says that when the module hospital will be a good idea in successfully ensuring a lasting solution to the unforeseen diseases outbreak.

Test of Hypotheses

Recall the hypotheses formulated in chapter one and two, the hypotheses were explained very well.

Test of Hypothesis H^o:

There is no relationship between management of pandemic cases with the new technological advancement of pandemic hospital process.

Table 72

Table Model Summary

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
Pandemic cases	0.889[a]	0.791	0.789	0.91411

(S.H Alhmoud-2022)

Predictors: New technological advancement of pandemic hospital process.

As shown above, in the above Table, the findings in the model summary show that independent variables (New technological advancement of pandemic hospital process) predicted the dependent variable (Pandemic cases) by 79%. This gives a notion that the independent variables were of high significant effect. On the other hand, other factors that are beyond the scope of this study can predict Pandemic cases by 21%.

ANOVA

Table 73

ANOVA

	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1247.981	4	311.995	373.382	0.000[b]
	Residual	330.059	395	0.836		
	Total	1578.040	399			

(S.H Alhmoud-2022)

a. Dependent Variable: Technological advancement and management of pandemic cases.

b. Predictors: (Constant), Pandemic hospital process as the independent variable.

Results of $p<0.01$ indicate that the model is well defined since the p-value is less than 0.05 at a 95% confidence level. Thus, the results indicate that the findings can be used to make a conclusive remark since the model is fit. Moreover, it indicates that pandemic hospital process significantly predicts technological advancement and management of pandemic cases. Furthermore, the significant F indicates that the relationship (373.382), $P< 0.001$ stands for the entire and all-important prediction of the independent variables to the dependent variable. It can be seen that the result highly is acceptable (p, 0.001).

Hospital Building Processes

A pandemic case around the world has become unusually common compared to what it had been in past times. This may largely be attributed to the environmental problem linked to ozone layer depletion that has enhanced the rise in atmospheric temperature thus, providing a better conducive environment for the growth and development of these diseases. The primary concept which should be considered above

all considering how hospitals and other healthcare facilities alike are better adapted to tackle unforeseen disease outbreak in flexibility.

It has been well recognised that building of all forms and uses need to go through flexibility due to the fact that the pace at which technological advancement is taking sway these days. The usual practice is for healthcare facilities to reduce the number of room floors to cater for any deficiency in design model because it is at added expense and difficulty also accompany any modification.

Pandemic necessitated that there need to be swift in construction model so as to accommodate the urge for properly managing the outbreak. This switch however requires several replanting, remodelling and recodifications within the existing facilities which can be made to be seaming less if important factors are considered from the initial stages of building construction. Greater flexibility will aid this thesis.

In a country like Jordan for example, the practice is to convert spacious settings like stadiums and social centres into pandemic management zones whereas the better alternative is to provide for additional capacity within existing hospitals or in close proximity to them for easy and quick accessibility to staff, equipment and other necessary materials. This switch in mode will entail the reconfiguration of the entrance space, passages and hallways to create avenue for the effective flow of staff, patients and visitors. Intensive Care Units (ICUs) will be upgraded so as to cater for a rise in number of desperately ill patients that visit the hospital also; isolation wards should undergo improvising through the installation of fans and filters to establish negative pressure. Other designs should be considered accordingly with respect to the designs on ground and the nature of cases to be managed.

Interior Architecture Process and 3D Proposed Module Design

Special care should be given to the pandemic disasters, safety of the all the staffs and the patients within the hospital and making sure all the features required to win the fight against pandemic virus was considered. These features are natural ventilation in the patients' room, incorporation of greeneries within and outside the hospital, the required average number of patients' capacity, isolation of the patients by making one patient to a single room and respiratory ventilation machine for patients with breathing difficulties.

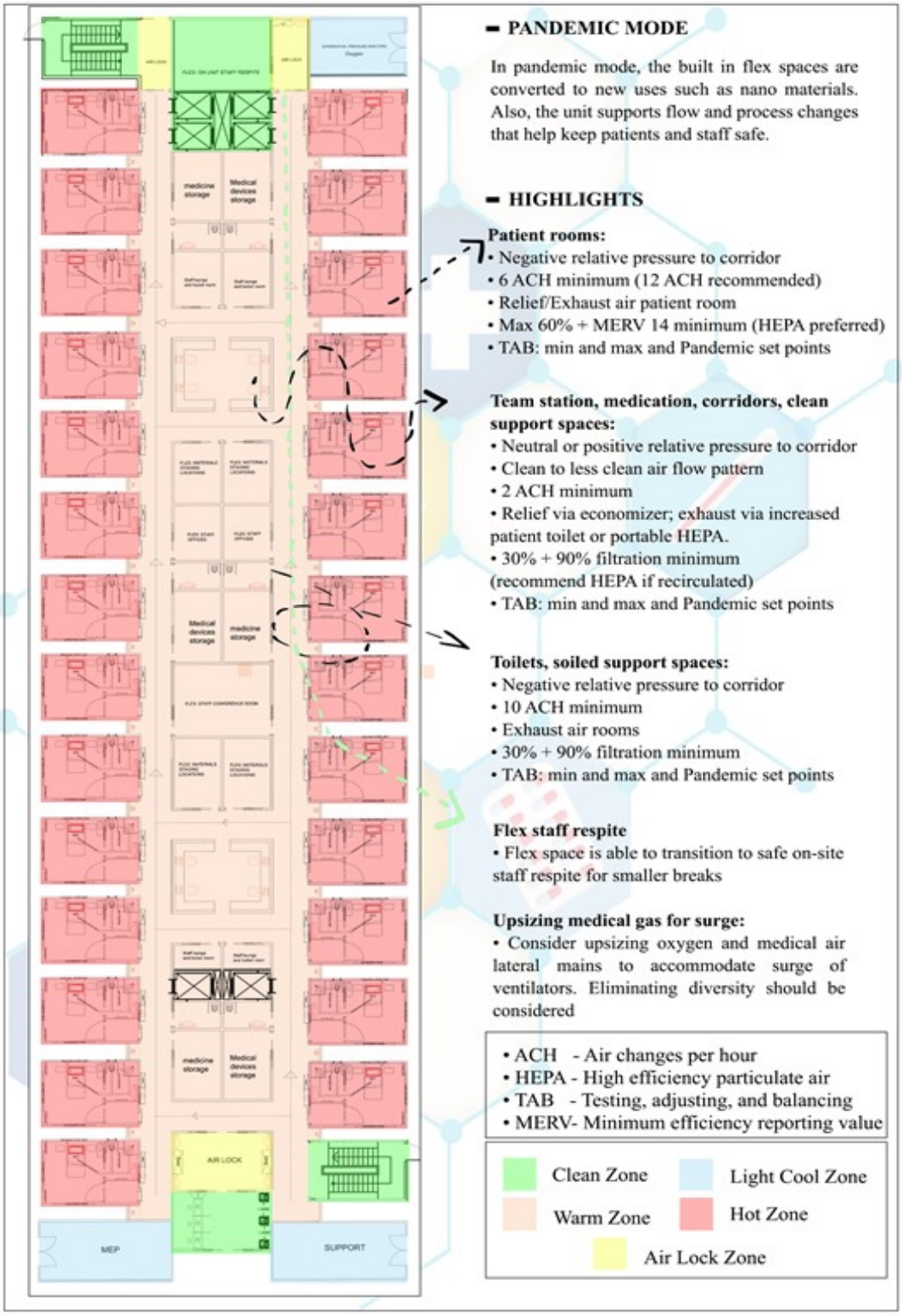
An article titled “Adapting hospital capacity to meet changing demands during the covid-19 pandemic” written by Ruth McCabe et al., 2020, stated that the number of hospital beds must be greater than 1550 beds in order to any kind of fight against any pandemic and this is approved by National Hospital Service (NHS) in England (McCabe et al., 2020).

Data analysis once again has proven to be a prefund tool in the analysis and prediction of events. With special gratitude to all respondents, the ministry of health, Jordan, and all other supporters of the study. All qualitative and quantitative data were gathered. Case study hospitals were analysed to remodel a new and improved hospital interior design process for Jordan. The new model is not limited to pandemic prevention alone but rather would support all areas of improving health care for the country. The plan of the improved building with all aspects of the improved technological features; such as the Nano antibacterial, self-cleaning aids, air-purifying wall paints, and many more

Building Research Establishment Environmental Assessment Method (BREAM) criteria was however considered in the process of designing the proposed building. The overall proposal designs give emphasis to the natural sustainable features, disabled, and less capacitated persons.

Figure 13

3D Model Plan for Jordan Hospital Design



(S.H Alhmoud-2022)

In the picture above, special care should be given to the pandemic disasters, the safety of all the staff and the patients within the hospital, and making sure all the features required to win the fight against the pandemic virus were considered. These features are natural ventilation in the patients' room; incorporation of greenery within and outside the hospital; the required average number of patients' capacity; isolation of the patients by making one patient per room; and a respiratory ventilation machine for patients with breathing difficulties. An article titled "Adapting hospital capacity to meet changing demands during the pandemic," written by Ruth McCabe, stated that the number of hospital beds must be greater than 1550 in order to fight any kind of pandemic.

Figure 14

The Interior Pandemic Hospital Design Process

(S.H Alhmoud-2023)

The image above presents the process that interior pandemic hospital management and design processes. These process focuses on the interior of the hospital building while stating the necessary steps to follow in order to fight any kind of pandemic in the current and future. Technological advancement indicates the need to incorporate the technical, mechanical and advanced interior features of the hospital building. The Nano technology was chosen to be within the interior walls of the hospital, because of the

superior effects of the Nano technology. However, the Nano technology process will be explained in detail in Figure 23 below. Another technological aspect involved in the hospital process was the machineries that will help in running the hospital successfully. These machines may involve any mechanical and electronic devices used in the hospital like oxygen mechanism, ventilators, electric generators, uninterrupted power supply (UPS), safety alarm, smoke sensors, HVAC, etc.

The effective policy making is necessary process that has to be created and followed carefully in order to successfully combat pandemics in Jordan. These policies are a set of guidelines and principles that will be applied in the interior parts of the pandemic building. These guidelines must be proposed to sustain the exercise of intensive-care professionals throughout the pandemic besides to encouraging the growth of national policies which must be authorized by hospital governing institutions or related local government authorities, this findings are also in line with Stephen Warrillow in his research around the year 2020 (Stephen Warrillow et al., 2020).

The interior hospital process was proposed to exist in Irbid city, with the intension to be implemented and followed in all new and existing hospitals, while treating all pandemic patients and cases in the whole of Jordan. The process is explained in 14 The Clean Zone should begin from the main entrance which contains a small reception, and this region involves the cleanliness of staff, visitors/patients, and wearing protective wear for pandemic; such as hand-gloves, hazmat suit, plastic shoe, facemask, wash-hand basin, detergents, etc. when the need arises. Cool Zone refers to the machineries that will support the hospital building and its operations, which must be kept in a cool environment, this machine were oxygen machine, standby electric generator, and Alternative batteries as inverters, etc. Warm zone means the temperature within this region must be kept warm, because it contains the virus and the hot temperature will help kills the virus, as the virus does not perform well in hot temperatures compared to when kept in cold rooms (Notari, 2021; Shi et al., 2020; Tobías & Molina, 2020; M. Wang et al., 2020). The regions were the patients' room exists must be kept hotter than the warm zone. The airlock zone must be a vacuum region of the building and the air exchange must be regulated to avoid the escape of the virus from the building facility.

The hallway was the part of the pandemic hospital that should connect all the sections and wards of the building. This part is very important and regularly used, therefore special care must be given to this building part by regularly cleaning and sanitizing this part. Also, it must connect will all other parts of the building at the same floor level or elevation to provide easy access for patients' beds, wheelchairs, and other wheeled hospital gadgets to be easily moved around the building without chances of accident occurrences. Other parts of the hospital that the hallway connects were the patients' wards/rooms, interior reception, elevators, doctors and nurses' rooms, cafeteria, stores, emergency staircase, and exits. All the parts of the hospital can be kept at an average temperature of at least 30oc except the patients' room which is required to be around 37oc and not more than 40oc. cross ventilation is encouraged in the patients' room instead of the provision of HVAC, because natural ventilation is a very important factor in the fight against pandemic and it is sustainable as well according to Building Research Establishment Environmental Assessment Method (BREEAM, 2017).

Figure 15

The surroundings of the 3D Model for Pandemic Hospitals

(S.H Alhmoud-2022)

Fig. 15 above shows the proposed pandemic hospital isolation centre; it also shows the 9 floors in the building, the greenery in the surroundings, the footpaths, and the windows for cross ventilation. The building was designed with greenery to support the natural cooling and good exchange of respiration within the hospital. The plants will absorb the carbon monoxide exhaled by both the patients and the hospital staff while giving oxygen out. However, it helps cool down the hospital's surroundings by

absorbing the sun's heat and protecting the building from direct sunlight. The importance of using greenery was adopted from BREEAM green building criteria in this hospital building proposal.

Figure 16

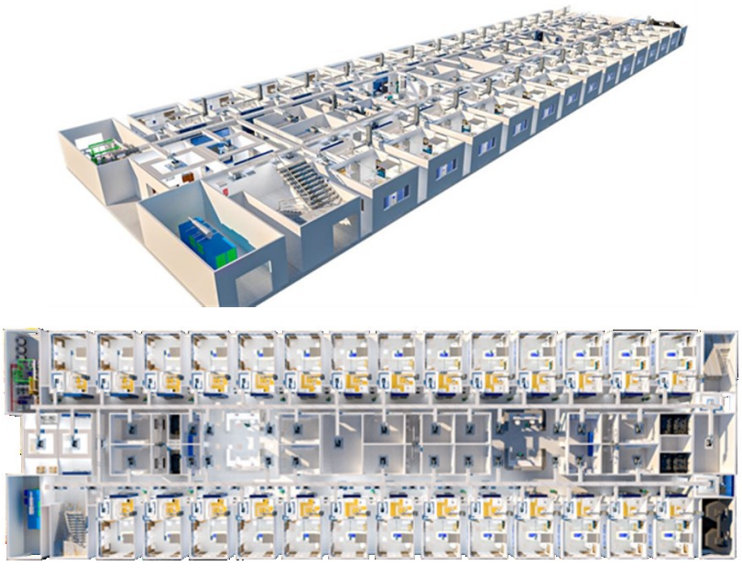
The Spaces between the Blocks of the Hospital Building

(S.H Alhmoud-2022)

The picture above (Figure 16) shows the space between the blocks of the pandemic hospital building. It shows the passageway along with some plants that reduce the impact of the sun penetrating the building interior through the openings. It also protects the building walls from heat, which keeps the interior cool even at night when the exterior walls are cooling.

Figure 17

The 3D plan of the building



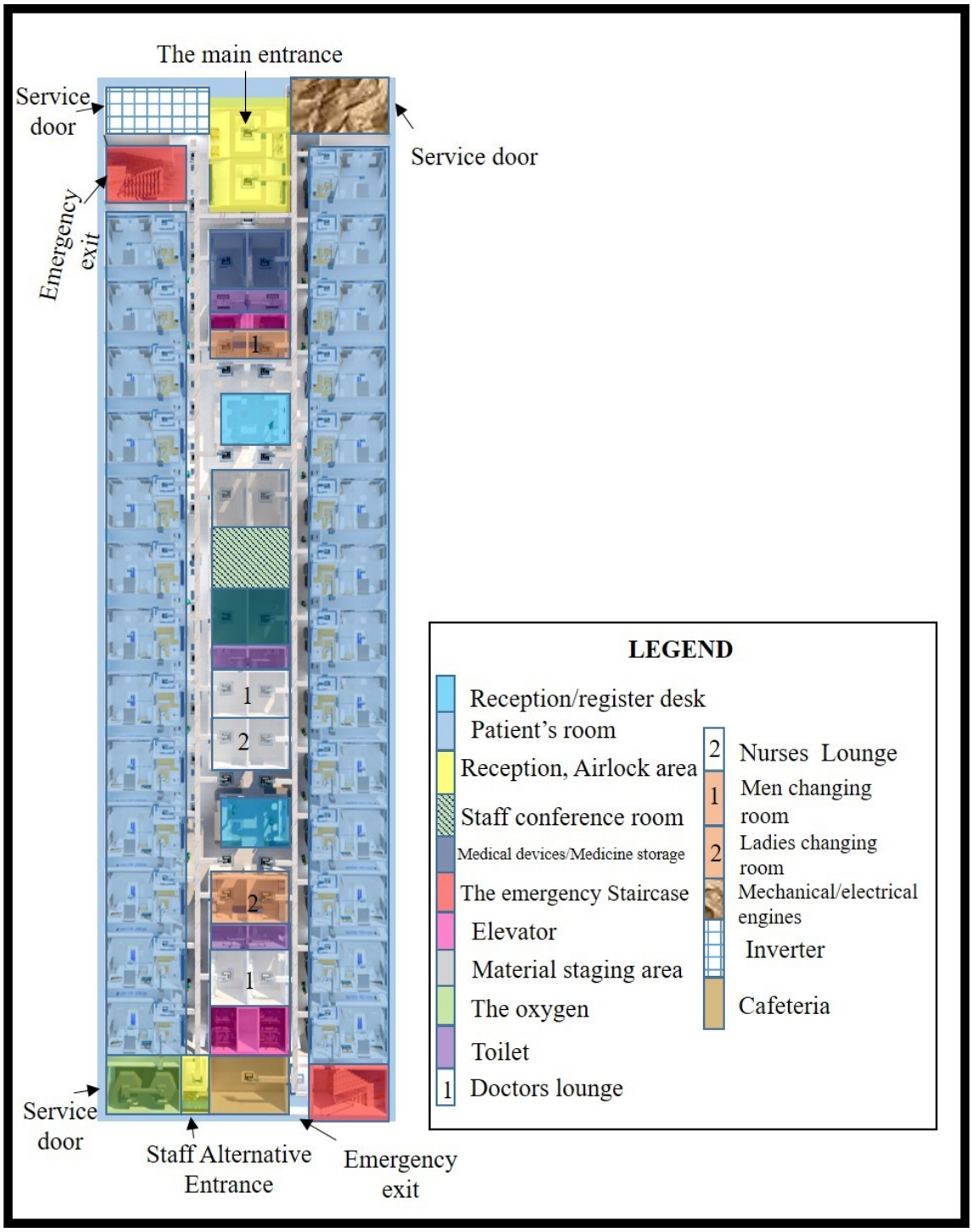
(S.H Alhmoud-2022) this sort of plan depicts a typical hospital model, which serves as a template that is adopted in arriving at the 3D designs in this research work. This is a comprehensive model that paid attention to details in selecting every component of the hospital room, including the passageways for effective circulation. Nanotechnology is employed to include a touch of modern-day advancement, ranging from its applications on tiles, healing vents, water closets, walls, curtains, and upholstery. The implementation of simplicity in the circulation within the interior of the building makes it easy for both the patients and staff to move freely and identify the facilities they require easily. In this design, there are 4 elevators, i.e., 2 on each axis to the main entrance and 2 at the end of the hospital. These elevators can be used by both the disabled and both staff and patients. However, there are two emergency staircases in this design.

The 3D plan in Figure 18 was properly explained in the figure below. There are seven external doors in every block in this hospital; some of these doors are connected to the interior and some are not. Doors like the main entrance, the alternative entrance, and the 2 emergency exits were connected to the interior of the building. While all the service doors only have access to the machines that were placed for utility, supply, and maintenance purposes, those situations usually arise from time to time. Most of these machines require these doors for servicing, maintaining, and provision of the materials required for the machine to operate properly. The main entrance, as shown in Figure 18, was facing the parking area of the hospital compound. This door has a sensor to open and close electronically, but it gives access to the reception area first, where patients are first registered and admitted if the need arises. The next room after the entrance door is the airlock room, which prevents the interior air from coming to the exterior. With this, the virus will be contained within the building, and the prevention of its spread will be strong. Also, in the airlock room are hazmat suits, face masks, hand gloves, a hand wash basin, and detergent that the visitors, patients, and staff will wear before getting inside the hospital. There are 27 patients' rooms per floor, as shown in Figure 15, and this patient's room was designed in such a way that it will not keep the virus for a long period. This is because the virus does not perform well in a hot environment (Birkeland, 2012; Tong et al., 2016). Therefore, the patient's room did not have any cooling device

like an air conditioner or HVAC; rather, a natural cross-ventilation was devised in the patient's room.

Figure 18

A detailed explanation of the 3D plan design



(S.H Alhmoud-2022)

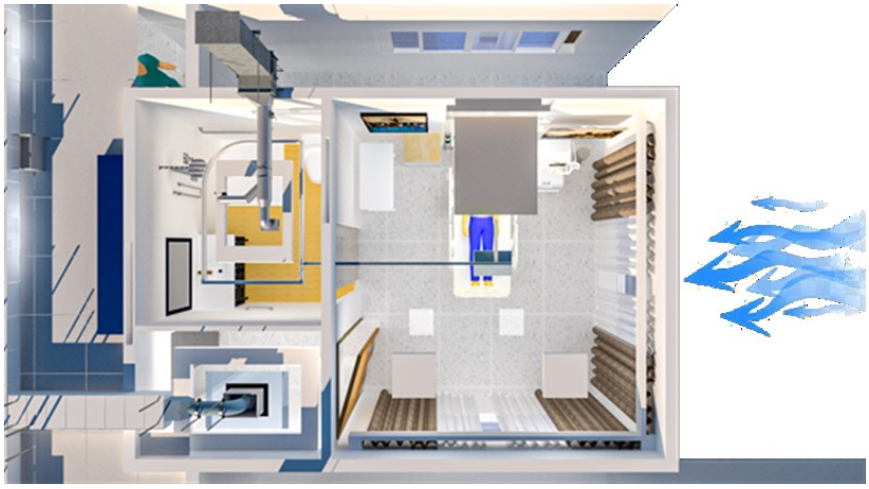
This cross-ventilation was done by having one window on two different walls of the room (refer to Figure 19). This is even more sustainable in terms of cost savings and electric consumption when operating the hospital (Stidsen et al., 2009; Smiełowska et al., 2017).

The HVAC, however, exists in the building, but at a controlled rate of temperature that is not more than or less than 24–26^{o}C.The HVAC exists in the passage and all other rooms within the middle-centred rooms. Because the rooms lack natural ventilation, the interior core will be uninhabitable for both staff and patients. There is no HVAC in the patient rooms, as mentioned earlier.

The patients' room is shown in Figure 19, which shows that the room was divided into two portions. The small portion was a small entrance for cleaning up and disinfecting before and after coming into contact with the patient. The bigger portion was the patient's room, well equipped with several machines that will aid quick recovery and be easily accessed by the patients and the staff. These machines were oxygen machines, ventilators to support people with breathing issues, intensive care devices to support patients in critical conditions, chargers for the defibrillator paddles, etc. As mentioned earlier, there are windows in the room for cross-ventilation. However, the room contains a personal toilet for the patient and a device that will lift patients in critical condition and take them to the toilet automatically.

Figure 19

The structure of the patient's room



(S.H Alhmoud-2022)

Figure 20

The Hospital Registration Desk

(S.H Alhmoud-2022)

In this model, there were about three hospital registration desks, one at the main entrance and the other two in the centre of the building. As shown in Figure 20, this is an example of how the inside of a hospital registration desk looks. In this registration desk, patients who were discharged died, or were in critical condition will be recorded and documented. The registration desk at the entrance was for patients who were admitted for the first time. However, the registration desk will always have nurses in case of emergencies that arise from existing patients in the hospital.

Figure 21

The hallway

(S.H Alhmoud-2022)

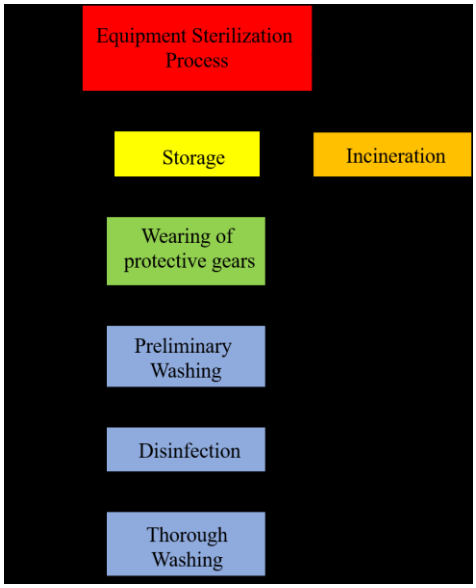
In this hallway shown in Figure 21, the computer is placed beside the door of every patient's room, along with a washbasin for disinfection. This is necessary to keep individual records that can be accessed remotely and to disinfect the hands for the protection of the staff.

The hallway is part of the pandemic hospital that should connect all the sections and wards of the building. This part is very important and regularly used; therefore, special care must be given to this building part by regularly cleaning and sanitizing it. Also, it must connect with all other parts of the building at the same floor level or elevation so as to provide easy access for patients' beds, wheelchairs, and other wheeled hospital gadgets to be easily moved around the building without chances of accident occurrences. Other parts of the hospital that the hallway connected were the patients' wards or rooms, the interior reception area, elevators, doctors' and nurses' rooms, cafeterias, stores, emergency staircases, and exits. All the parts of the hospital can be kept at an average temperature of at least 30^{o}c except the patients' room, which is required to be around 37^{o}c and not more than 40^{o}c. Cross ventilation is encouraged in the patients' room instead of the provision of HVAC because natural ventilation is a very important factor in the fight against pandemic and it is sustainable as well, according to the Building Research Establishment Environmental Assessment Method (Chen et al., 2022).

The hospital tools and equipment sterilization process in the hospital will be explained in picture below (refer to Figure 22):

Figure 22

The Equipment Sterilization Process



(S.H Alhmoud-2023)

Fig.22 above shows the process of equipment and tools sterilization process during the event pandemic and any other pandemics. The fact that thorough sterilization and burning/incinerating of some tools and consumables eliminates the virus, makes it an effective process of disinfecting the tools before reusing it in another patient. This process is developed in an effort to avoid the spread of the virus between different patients. The stages in the sterilization process as shown in Figure 22 begin with the temporary storage of the equipment, and wearing protective gears like hand-globe, protective suits, and boots to protect the staff conducting the process. A preliminary washing should be done with a detergent because any detergent can kill the virus and remove dirt from the tools. Then a disinfectant can be introduced and the tools should left inside the liquid for 5 seconds before finally washing them thoroughly to make sure they are safe to be reused. The disinfectant liquid is many but some effective pandemic disinfectants are sodium hypochlorite (bleach/chlorine) (0.1% or 1,000ppm or 1 part of 5% strength household bleach to 49 parts of water) and Alcohol (at 70-90% concentration) (WHO, 2022). The sterilised equipment should be taken to a separate clean storage area, separated from the dirty ones, and ready to be used.

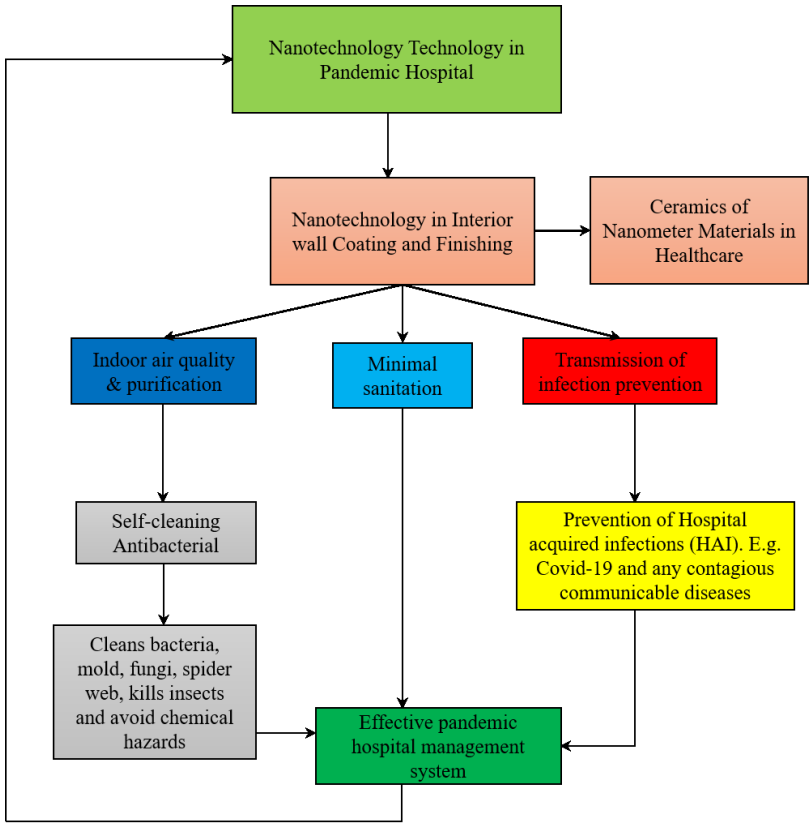
The Application of Nano Material in the Architecture Design Process

The new nanometre materials challenge designers' thinking and promote the evolution of designers and interior design styles. As a result of people's natural desire to seek out new materials, the new Nano materials are increasingly "created," forming a virtuous cycle that has influenced and promoted the development of interior design. As a result, nanomaterials in building materials have a very broad market application potential as well as significant economic and social benefit as shown in Table 72. Further, removal of bacteria, algae, dirt, control of indoor climate, odorants, fungi, and pollutants (Chen, 2014).

This underlines the importance of carefully selecting finishing materials in the process of buildings or structural design. Nanotechnologies therefore serve as a useful tool in putting materials to better use in the field of architecture. The use of substances in Nano-length scale can enhance the features which they possess and ensure ways by which they are properly utilized are well spread out Table 72 shows analysis of nanomaterial's criteria standards for buildings.

Figure 23

The Nano Technology Process



(S.H Alhmoud-2023)

The nanomaterial technology process in pandemic hospital design has been shown in the figure above (figure 23). The importance of this technology has been highlighted which will help achieve an effective pandemic hospital management system. The pandemic hospital requires regular cleaning and sanitation hourly. This technology will definitely assist in so many parts of the hospital when applied. It is required to be applied to the walls, ceramics, ceiling, furniture, and the floor of the whole hospital. This will minimize sanitation efforts, prevent transmission of infectious or communicable diseases, and purify the indoor air quality. This is done because the nanomaterial possesses several features that a clinical environment requires in order to have a disease-free environment. This feature is the self-cleaning environment, prevents hospital infectious diseases, is antibacterial and kills insects like spiders along with its webs, eliminates Mold, and fungi, and prevents chemical hazards.

Table 74

Analysis of nanomaterial's criteria standards for buildings

S/N	Nanomaterial's Types	Positive Effect (T)	Negative Effect (F)
Nano coating	• Powered light • Works with natural UV • Fluorescent light • High performance • Environment friendly • Decomposition of endotoxin	-Improves IAQ (indoor air quality). -Reduces using of toxic chemical. - Reduces the risk of surface bio-contamination. - Reduces the time of cleaning and disinfection process.	- can easily enter the body and interact with cells and tissues in ways larger particles cannot. Some studies suggest that certain types of nanoparticles could have toxic effects on the body.
Nano particle types	• Silica nanoparticles • Carbon nanotubes • Aluminium oxide nanoparticles • Clay nanoparticles • Iron oxide nanoparticles • Copper nanoparticles	- Improve reinforcement in mechanical strength. - Rabid hydration. - Increased compression strength. - High self-cleaning. - Mechanical durability. - High crack prevention. - Increased serviceability and compression ability. - Increased surface roughness. - High abrasion resistant. - Increased compressive strength. - Reduce weld ability and corrosion resistance formability	- Breathing in tiny particles could have a negative effect on our lungs. - Difficulties in production and experience needed in terms of usage. - Meaning standards are not fully clarified
Insulations coatings	• Color, and reproducible paints • Self-cleaning • Scratch resistance • Photo catalytic effect, and antimicrobial • Fire retardant • UV protection • IR absorbing	- Prevent crack formation. - Enhanced resistance to fading. - Dirt and water repellent. - Anti-graffiti protection. - Protection against fungi and algae. - Enhanced scratch resistance.	- Nanoparticles could accumulate in organism's overtime and we are unaware of the long-term effects. - Human health and environment have not been full determined. - Control and repair methods are needed.

*(*Aljenbaz, & Çağnan, 2020) The table above (Table 72) explains the positive effect (T) and negative effects (F) of Nano Technology when applied to the hospital building. The analysis was done using various literature reviews conducted in this research. The table begins with the pillars of sustainability measures such as economic, social, and environmental sustainability measures which are the overall analysis. The negative effect of Nanotechnology is minimal, thereby indicating that most of the effects of the Nanomaterial were known and mainly positive effects. Preventing the loss of energy effect of Nano technology was good, as the material helps in retaining the interior

temperature and uses less energy in maintenance which resulted in energy loss prevention of Nano material effects.

Table 75

Test analysis matrix criteria for the effect of nanotechnology

		Effect of the Nano Technology																		
S/N	**Criteria**	**Powered light**	**Works with natural UV**	**Fluorescent light**	**High performance**	**Environment friendly**	**Decomposition of endotoxin**	**Silica nanoparticles**	**Carbon nanotubes**	**Aluminium oxide nanoparticles**	**Clay nanoparticles**	**Iron oxide nanoparticles**	**Copper nanoparticles**	**Color, and reproducible paints**	**Self-cleaning**	**Scratch resistance**	**antimicrobial**	**Fire retardant**	**UV protection**	**IR absorbing**
1.	Optimizing the space consume	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
2.	Energy consumption	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
3.	Energy, and loss prevention	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
4.	Minimizing the cost transportation	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
5.	Minimizing resource consumption	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
6.	Reduce work cleaning time	T	T	T	T	T	T	T	T	T	T	F	F	F	F	F	F	F	F	F
7.	Keep maintain average indoor	F	F	F	F	F	F	F	F	F	F	T	T	T	T	T	T	T	T	T
8.	Reduce minimal environment gas	T	T	T	T	T	T	T	T	T	T	T	T	T	T	F	F	F	F	F
9.	Reduce chemical substance usage	T	T	T	T	T	T	F	F	F	F	F	F	F	T	T	T	T	T	T
10.	Long lifespan	F	F	F	F	F	F	T	T	T	T	T	T	T	T	T	T	T	T	T
11.	Ease of application	T	T	T	T	T	T	T	T	T	T	T	T	F	F	F	F	F	F	F
12.	Reducing need for repair	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	F	F
13.	Increase indoor air quality	T	T	T	T	T	T	T	T	T	T	T	T	T	F	F	F	F	F	F
14.	Prevents the spread of bacteria	T	T	T	T	T	T	T	T	T	T	T	T	T	T	F	F	F	F	F
15.	lighting using reflective Nano	T	T	T	T	T	T	T	T	T	T	T	T	T	T	O	O	O	O	O
16.	High brightness and efficiency,	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	F	F	F	F
17.	Reduce costs of cooling a room	T	T	T	T	T	T	T	T	O	O	O	O	O	F	F	F	F	F	F
18.	Energy saving	T	T	T	T	T	T	T	T	T	T	T	T	T	T	F	F	F	F	F
19.	Required colour filtering	T	T	T	T	T	T	T	T	T	T	O	O	O	O	O	O	O	O	O
20.	Effects on human health	T	T	T	T	T	T	T	T	T	T	O	O	O	O	O	O	O	O	O
21.	Observe on Nano scale	T	T	T	T	T	T	T	O	O	O	O	O	O	O	O	O	O	O	O
22.	Recyclable and reusable	T	T	T	T	T	T	T	T	T	T	T	T	F	F	F	F	F	F	F
Test Result:		Positive Effect (T) 71.1 %						Negative Effect (F) 19.2 %						Ineffective (O) 9.5 %						

(S.H Alhmoud-2023) the overall criteria assessment of this table shows that the positive effects are high positive scores and measures indicated, more than the negative effect. This shows the importance of Nano Technology's involvement in this study. These results are summarized in the table above; refer to Table 73.

In addition, the table above shows the overall assessment of Nanomaterial when applied to the hospital building. The result was presented in percentage, which summarizes the overall outcome of Table 73. Positive effects amount to 71.1% while negative effects give 19.2% and ineffective is 9.5%. The overall effects of 71.1% supersede the negative or ineffective, this shows that Nano Technology is highly effective in hospital design and management.

The questionnaire was administered to 382 respondents (i.e. both stakeholders and patients). The analysis was divided into 2 parts, 182 questionnaires for stakeholders and 200 questionnaires to the pandemic patients. However, the 3 proposed pandemic Hospital processes were explained as well as all the parts other branches the process tree contains.

The components of the environment including the air, humidity and even the space that holds other elements are to be considered when choosing any element to be used in process. The responsibility therefore rests the architect tasked with the design of hospitals process, in this case, the researcher come up with plans that solve the puzzles and inadequacies that exist from the conversion of non-hospital space into such especially during an unexpected breakout of diseases.

Even if it is unable to clean the air completely, nanomaterial's still do some degree of important job in improving the quality of air. It ensures and allows bad and unpleasant odours and pollutants to be eradicated from an environment. Healthy air is a fundamental and ever more important resource that at the same time is becoming ever more precious. Legislation was initially introduced to reduce the level of outdoor air pollution; the need to improve indoor air quality followed later.

CHAPTER V

Conclusion and Recommendations

The world suffered from pandemic for more than 3 years now, and the virus is still circulating within us despite the measures taken by individuals, private organizations, and the governments of different nations. Despite all the durability made by the world, there is no single cure or treatment method for pandemic found. Though there are vaccines developed around the world regarding the virus, it was not enough to tackle the spread. Every country tries to quickly create a temporary shelter for the quarantine of the affected patients to stay and undergoes some process that might help their immune system to heal them faster, but the temporary quarantine centre remains with problems in containing and stopping the spread of the virus. Therefore, the need to provide a permanent standard and comprehensive pandemic hospital process that will help fight both the current and future pandemics arises in order to reduce the spread of the virus, while giving focus on the interior design process. The interior architectural aspect comes into this research through several research and the adoption of various fields. This means that the involvement of other fields in architecture was necessary because architecture always begins with a purpose, function, and use by other individuals in different fields. In this research, the application of health care research, technological research, and social fields were borrowed and applied to architectural design concepts used. Looking at the title of this thesis “Adapting Hospital Interior Design Process to Technological Advancement in the Management of Pandemic Cases in Jordan”, several fields have to be involved to achieve a solution.

The first chapter of this thesis serves as the introductory part that gives background to be laid for the topic. An argumentative case was established for making this finding together with stating the aims, objectives, and methodology with which the set objectives will be achieved. Corresponding literature was reviewed in the second chapter considering the state of the world in the fight against pandemic, how well the world has adapted to the challenge posed by these deadly viruses, and the impact that has been taken by hospitals and technology. However, the guidelines and building technologies for creating a comprehensive pandemic hospital interior management process were reviewed in this research. Chapter three is a methodology relating to the

technology's relationship with the hospital management process which is directed towards understanding the state of technological advancement in hospitals and the emerging ones that will likely set a trend for practices in the field of Interior Architecture. Chapter four details the application of the previously discussed methodology adopted and the analysis of the results gathered. The fifth chapter serves as the concluding part of the thesis and also the recommendations that were made to the research of the findings.

In this research methodology was discussed and comprehended; therefore, the methodology was designed to resolve the aim and objectives of this research. The use of mixed method was devised i.e. the use of qualitative and quantitative research. Questionnaire was used as a means of survey and fetching the required information in this research which was analyzed in two parts, the stakeholders and the pandemic patients interviewed. Later, a mega project of pandemic hospital was proposed in order to resolve the problems found during the survey and the questionnaire analysis. However, Nano-technology and the BREEAM green building assessment criteria was used in the proposed interior pandemic hospital design process in order to help in the cleanliness of the hospital environment. The major summary of findings will be itemized in section below;

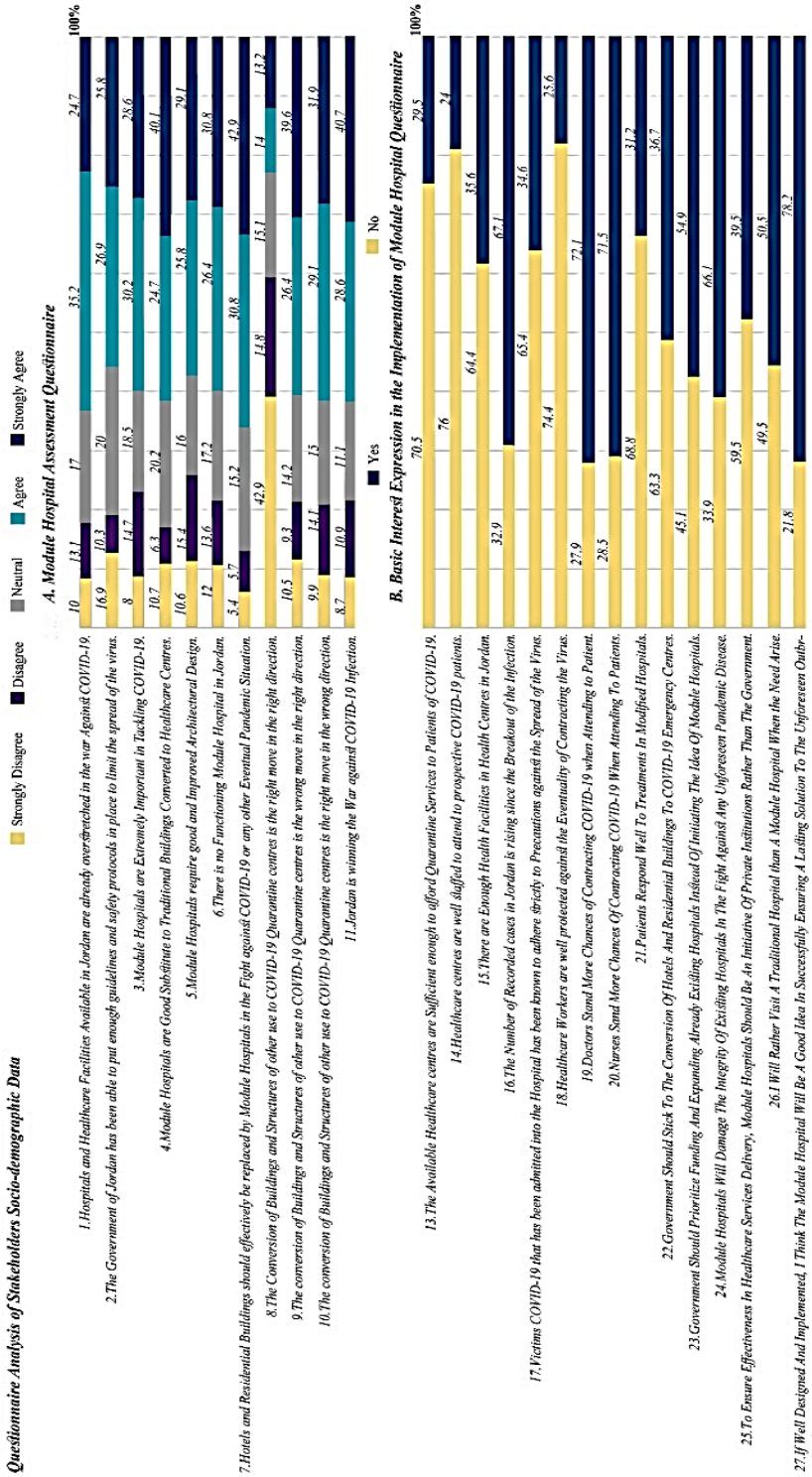
Both the stakeholders and patients agree with the following results:

1. The respondents agree that all the hospitals in Jordan were overstretched.
2. There was a tie here, because equal respondents agree and disagree at same time, this might be due to lack of awareness that makes people not sure of the governmental activities in the country. This why the respondents were not sure whether the Government of Jordan has been able to put enough guidelines and safety protocols in place to limit the spread of the virus or not.
3. The module hospitals were strongly agreed by the majority of the respondents.
4. Higher responses were given to strongly agree that module hospitals are good substitute to traditional buildings converted to healthcare centres.

5. The majority of the respondents strongly agreed that Module Hospitals require good and Improved Architectural Design.
6. Most of the respondents strongly agreed on there is no functioning module hospital in Jordan.
7. The majority of the respondents strongly agree that hotels and residential buildings should effectively be replaced by module hospitals in the fight against pandemic or any other eventual pandemic situation.
8. There are higher responses of the participants who strongly disagreed on the conversion of buildings and structures of other use to pandemic quarantine centres are the right move in the right direction.
9. Here, the majority of the respondents strongly disagreed on the conversion of buildings and structures of other use to pandemic quarantine centres are the wrong move in the right direction.
10. A higher population of the sample strongly disagreed on the conversion of buildings and structures of other use to pandemic quarantine centres are the right move in the wrong direction.
11. Therefore, majority of the respondent strongly agrees that Jordan is winning the war against the current pandemic.

Figure 24

A Likert scale results of the stakeholders



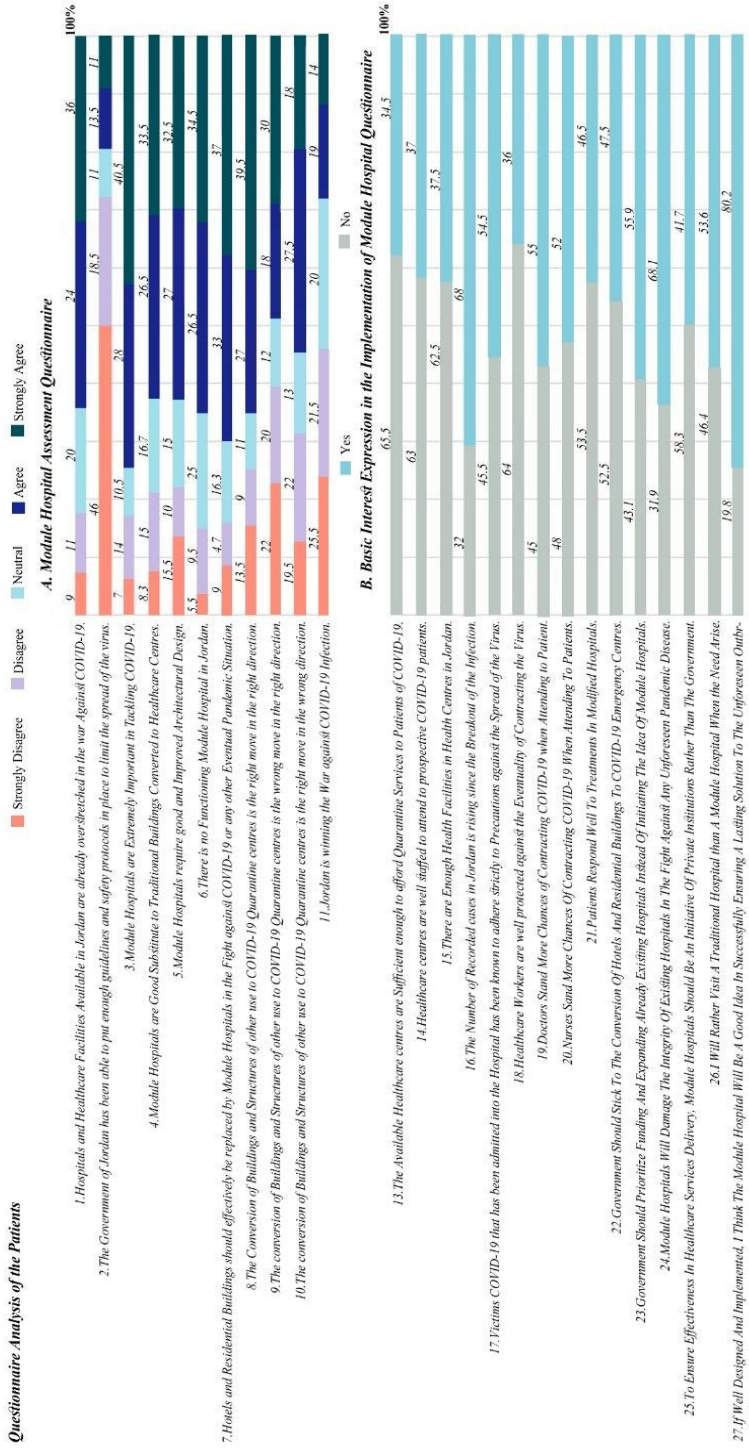
(S.H Alhmoud-2023)

Basic Interest Expression in the Implementation of Module Hospital Questionnaire

1. The respondent says the available healthcare centres are not sufficient enough to afford quarantine services to patients of pandemic.
2. Therefore, there are no adequate healthcare centre staffs to attend to prospective pandemic patients.
3. There are no enough health facilities in health centres in Jordan, the majority of the respondents say.
4. The cases on the number of recorded pandemic cases in Jordan are rising since the breakout of the infection.
5. Therefore, the victims pandemic that have been admitted into the hospital have not been known to adhere strictly to precautions against the spread of the virus.
6. High response was given to the statement that Healthcare workers are not well protected against the eventuality of contracting the virus.
7. Therefore, the research calls doctors to be extra careful when attending to communicable diseases like pandemic patients to alleviate the spread.
8. However, the respondent says Nurses stand more chances of contracting pandemic when attending to patients.
9. Here, patients do not respond well to treatments in modified hospitals.
10. Therefore, majority of the people do not think that the government should stick to the conversion of hotels and residential buildings to pandemic emergency centres.
11. The respondent majorly says the Module hospitals will not damage the integrity of existing hospitals in the fight against any unforeseen pandemic disease.
12. Most of the respondents agrees to ensure effectiveness in healthcare services delivery, module hospitals should be an initiative of private institutions rather than the government.
13. Majority of the participants says if well designed and implemented, I think the module hospital will be a good idea in successfully ensuring a lasting solution to the unforeseen outbreak of diseases.

Figure 25

A Likert scale results of the patients



(S.H Alhmoud-2023)

As pandemic cases can be quick to escalate from being a national issue to an international one as it had been shown by the pandemic, the contributions of this study will be functional.

The outcomes of the study suggest that there exists a clear relationship between the healthcare environment and technology. This is supported by the evidence-based design of this study that shows that revolution in space took place concurrently with advancement in architectural design. As an illustration, a lot of healthcare spaces and sectors came into operation immediately after the invention of designing instruments.

This research work was able to establish a new process of interior architectural design and the matchbox-on-a-Nano materials which solidified the importance of advancement in technology and architectural planning including biotechnology, and nanotechnology which have all turned out to be significant components in adapting existing and future interior hospital and healthcare facilities to better management of unforeseen pandemic cases.

Listed below are the practical recommendations for future implementation;

- It is recommended by this study that a central database be established for healthcare facilities design process. The features of this database should include ease of accessibility by all and should be comprehensive enough to go through without requiring the assistance of an expert within the interiors.
- Archives should be created to carry information on hospital interior architects that involves new technological advancements and practices for any impeding design process to be implemented in case of an unforeseen pandemic just like in the case of pandemic.

The implications of architecture emerging technologies and upcoming advancements and around process design experts. In order to guide against making the interiors of health sector lag behind when it comes to adopting emerging technologies and other impending practices in interior architecture.

- While the long-run benefits of putting a new pandemic hospital interior design process in place which will be presumably unique to the management of such cases

as pandemic, the cost which such planning and execution would command. It is suggested therefore that more effort should be channelled towards the modifications, renovation, and improvising of already existing healthcare facilities and even non-healthcare spaces as it is followed in this study.

- There is also the need to arrive at non-way out of problems identified with interior architecture when deciding on future hospital process designs. Also, research on ways to create novel construction methodologies which will be deeply incorporated with emerging technologies needs to be up.

The recommendations in this research will be drawn from the problems found in whole thesis. These recommendations were expected to address the current and future or anticipated pandemic disasters that may occur. Therefore, the following recommendations are itemized below:

1. The government, private, and organizational bodies related to health provision in Jordan should provide adequate hospital beds in one or different individual hospitals enough to handle a remarkable number of patients in the country as a whole. This was discussed in chapter four, it was stated to have not less than 1,550 hospital beds. The country has seen how many people have died during this pandemic, and how much economic damage was recorded and it will not be wise to allow it to happen again. Therefore, the government has to be prepared for any kind of biological disaster to reign due to lack of building facility in the country.
2. Adequate healthcare staffs should be employed and trained on how to handle the virus strain and ways to protect themselves, their patients and their family at home. However, provisions of adequate functional equipment in the hospitals are necessary to fight any kind of pandemic. This equipment can be oxygen and respiratory machines, charged paddles and the entire clinical tool required for the fight with future pandemic.
3. Public enlightenment about the pandemic and ways to protect them are necessary, this is because when the public aware of the virus and ways to avoid it, the

hospital will not congest with infected patients. The public enlightenment can be done through media or any kind.

4. The proposed pandemic hospital process designed in this thesis was an excellent way to reduce the contamination in the hospitals and enough to handle any anticipated biological disasters both pandemic and endemic, current and future ones. The hospital must be air tight and located in an isolated area, well equipped with the emergency measures and tools required to help patients heal faster. Therefore, this thesis is strongly recommending the implementation of this pandemic hospital process to help the entire nation.

A mixed method was used in this research, in which both qualitative and quantitative data were taken and analyzed using the descriptive method. Case studies were four hospital buildings, which were selected and analyzed based on their capacity to accommodate the pandemic disaster and contain the virus, thereby avoiding the rapid spread of the virus. These hospitals, all in Jordan, were found lacking these capabilities. Questionnaires were also used to fetch raw data in this research, which focused on the perception of the hospital workers, and were analyzed and the results were reported in this research.

Findings from this research work revealed that there has been a considerable upward rise in the number and level of adoption of technological advancement in hospital space. The sizes of the resulting concerning the space it is to occupy may pose some sort of initial challenge at the introduction of any particular piece of technology, but with the work of interior architecture and series of progression on the technology, reasonable solutions are arrived. The role of nanomaterial's technologies' is remarkable, and necessary for implementation in any pandemic hospital.

A key point to note in this study is the fact that the introduction of any technological advancement into a hospital interior process cannot be random or ubiquitous. This has to involve careful work to be done by designers in arriving at effective solutions that will be suited to casual day-to-day illnesses in hospitals and also be well-equipped and easily adapted to any unforeseen epidemic of disease just like in the case of pandemic.

The set objectives of this research study were met by considering the present and substitutes that exist for any future comprehensive process of the interiors of healthcare facilities in Jordan which has to do with emerging technologies in interior architectural and management process.

Findings reveal that basic alterations are predicted to take place relating to space and in a typical healthcare facility that will affect and are well suited to tackling pandemic cases of diseases while also prioritizing flexibility and dynamism as essential tools for fine-tuning decisions in the healthcare environment. This research strongly endorses the need for flexibility in healthcare design process solutions.

Lastly, it is highly recommended that this thesis be used as a guideline required fighting against any pandemics or endemics in both the present and the future. This is because this research provides a comprehensive process guideline to combat any deadly viruses, which are shown in detailed photos and process diagrams. In addition, the use of nanotechnology in new hospital designs is trending in the world nowadays, and when incorporated into any hospital design, it will drastically reduce the virus spread among human beings.

Future research can be achieved at the intersection of three axes (Resilience-Mitigation, Maintainability-Improvement, and Changeability-Transition) that enable hospital buildings to Survive, Evolve, and Thrive and will be conducted on patients' perceptions and opinions about the capacity of existing hospitals in Jordan to handle current and future pandemics, six key trends will inform the future design of hospitals: pandemic preparedness, climate resilience, connectivity with the rest of the healthcare ecosystem, flexibility, digital transformation, and patient centricity.

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APPENDIX I

This questionnaire has been designed to determine your assessment of the current conditions in which the pandemic cases are been attended to the available healthcare centres and the suitability of other facilities set aside for the tackling of this novel disease breakout.

The items require your assessment of Antecedent and Transaction variables with regard to the need to put module hospitals in place to place the Jordan in a good position to offer necessary healthcare services to the victims of pandemic and prevent any subsequent spread of the disease and other pandemic illnesses.

Your frank responses to the items of this questionnaire would go a long way in helping to collect adequate data for an ongoing research to evaluate implementation of this innovation and its likely success.

Please feel free to express your opinion as your responses would be kept strictly confidential Please tick [√] the correct option

CATEGORY A: Stakeholder's Socio-demographic Data

1. NATIONALITY: Jordanian [ ] Non Jordanian [ ]
2. AGE: under 18 years [ ] 19 – 25 years [ ] 26 – 40years [ ] 41years and above [ ]
3. GENDER: Male [ ] Female [ ]
4. OCCUPATION: Doctor [ ] Nurse [ ] Attendant [ ]
5. AREA OF SPECIALIZATION: PANDEMIC [ ] Others [ ]
6. YEARS OF SERVICE: 0-5 years [ ] 6-10 years [ ] 11-20 years [ ] 21 years and above [ ]

Please tick [√] the correct option

CATEGORY B: Patient's Socio-demographic Data

1. RESIDENCE: Jordan [ ] Outside Jordan [ ]

2. NATIONALITY: Jordanian [ ] Non Jordanian [ ]

3. AGE: under 18 years [ ] 19 – 25 years [ ] 26 – 40years [ ] 41years and above [ ]

4. GENDER: Male [ ] Female [ ]

5. OCCUPATION: Student [ ] Artisan [ ] Civil servant [ ] Doctor/Nurse/Hospital Attendant [ ]

6. NATURE OF SICKNESS: PANDEMIC [ ] Others [ ]

APPENDIX II

MODULE HOSPITAL ASSESSMENT QUESTIONNAIRE

Place of work:

Please indicate (√) your assessment of the extent to which the introduction of module

Hospitals will go to assist in the fight against pandemic and any other outbreak of diseases. Use the key: SA = Strongly agree A = Agree D = Disagree SD = Strongly disagree.

S/N	ITEM	SA	A	D	SD
1	Hospitals and healthcare facilities available in Jordan are already overstretched in the war against pandemic				
2	The Government of Jordan has been able to put enough guidelines and safety protocols in place to limit the spread of the virus				
3	Module hospitals are extremely important in tackling pandemic				
4	Module hospitals are good substitute to convectional buildings converted to healthcare centers				
5	Module hospitals are good substitute to convectional buildings converted to healthcare centers				
6	There is no functioning module hospital in Jordan				
7	Hotels and residential buildings should effectively be replaced by module hospitals in the fight against pandemic or any other eventual pandemic situation				
8	The conversion of buildings and structures of other use to pandemic quarantine centers is the right move in the right direction				
9	The conversion of buildings and structures of other use to pandemic quarantine centers is the wrong move in the right direction				
10	The conversion of buildings and structures of other use to pandemic quarantine centers is the right move in the wrong direction				
11	Jordan is winning the war against pandemic infection				

APPENDIX III

BASIC INTEREST EXPRESSION IN THE IMPLEMENTATION OF MODULE HOSPITAL QUESTIONNAIRE

Please tick [√] the correct option

1. The available healthcare centers in sufficient enough to afford quarantine services to patients of pandemic. Yes [ ] No [ ]

2. Healthcare centers are well staffed to attend to prospective pandemic patients. Yes [ ] No [ ]

3. There are enough health facilities in health centers in Jordan. Yes [ ] No []

4. The number of recorded cases in Jordan is rising since the breakout of the infection. Yes [ ] No [ ]

5. Victims pandemic that have been admitted into the hospital have been known to adhere strictly to precautions against the spread of the virus. Yes [ ] No [ ]

6. Healthcare workers are well protected against the eventuality of contracting the virus. Yes [ ] No [ ]

7. Doctors stand more chances of contracting pandemic when attending to patient. Yes [ ] No [ ]

8. Nurses stand more chances of contracting pandemic when attending to patients. Yes [ ] No [ ]

9. Patients respond well to treatments in modified hospitals. Yes [ ] No [ ]

10. Government should stick to the conversion of hotels and residential buildings to pandemic emergency centers. Yes [ ] No [ ]

11. Government should prioritize funding and expanding already existing hospitals instead of initiating the idea of module hospitals. Yes [ ] No [ ]

12. Module hospitals will damage the integrity of existing hospitals in the fight against any unforeseen pandemic disease. Yes [ ] No [ ]

13. To ensure effectiveness in healthcare services delivery, module hospitals should be an initiative of private institutions rather than the government. Yes [ ] No [ ]

14. I will rather visit a convectional hospital than a module hospital when the need arise. Yes [ ] No [ ]

15. If well designed and implemented, I think the module hospital will be a good idea in successfully ensuring a lasting solution to the unforeseen outbreak of diseases. Yes [ ] No [ ]

YAKIN DOĞU ÜNİVERSİTESİ

BİLİMSEL ARAŞTIRMALAR ETİK KURULU

12.04.2021

Dear Saeed Husseın Saeed Alhmoud

Your application titled **"ADAPTING HOSPITAL INTERIOR ARCHITECTURE PROCESS TO TECHNOLOGICAL ADVANCEMENT IN THE MANAGEMENT OF PANDEMIC CASES IN JORDAN"** with the application number NEU/AS/2021/115 has been evaluated by the Scientific Research Ethics Committee and granted approval. You can start your research on the condition that you will abide by the information provided in your application form.

Assoc. Prof. Dr. Direnç Kanol

Rapporteur of theScientificResearchEthicsCommittee

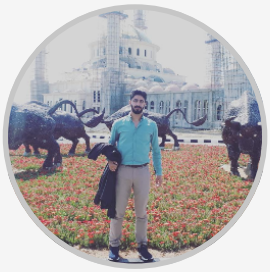
Direnc Kanol

Note: If you need to provide an official letter to an institution with the signature of the Head of NEU Scientific Research Ethics Committee, please apply to the secretariat of the ethics committee by showing this document.

APPENDIX IV

Çigdem ÇAĞNAN

12.12.2023



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ABOUT ME

I am a Researcher Doctor at Near East University in the Department of Interior Architecture.

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OTHER LANGUAGE(S):

English

Listening	Reading	Spoken production	Spoken interaction	Writing
C2	C2	C2	C2	C2

DIGITAL SKILLS

Microsoft Office: Word, Excel, Access, Power Point, Outlook. / Autocad / Photoshop / SketchUp / Multimedia / V-RAY

PUBLICATIONS

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