

Towards a healthy and sustainable environment through a Universal Design Approach. Case of Pediatrics Hospital, Assiut University, Egypt

Amira Esam* , Mai Eid

Architectural Engineering Department, Faculty of Engineering, Aswan University, Aswan 81542, Egypt

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Abstract:

Universal Design (UD) is a progressive approach to creating inclusive environments that can be accessed, understood, and used to the greatest extent possible by users. Applying Universal Design standards aims at obtaining healthcare institutions and facilities that deliver equality and provide everyone the opportunity to use the building without excluding any social group. This study focuses on pediatric hospital buildings due to the multiple categories of users of different ages, and physical and health abilities. This research seeks to assess Assiut University Pediatrics Hospital in light of the universal design standards for healthcare buildings to achieve a therapeutic health environment that is universally designed and easy to use by everyone in government hospitals in Egypt. In addition, to promote the efficiency of the buildings and urban open spaces of the hospital under study to fit with the approach and standards of universal design, thereby achieving convenience, inclusion, and integration for all users regardless of their ages and physical and mental abilities. To achieve the study objectives, the research used appropriate methodologies. Among these methodologies, the descriptive-analytical method, inductive method, site visits and a study checklist were designed to assess the case study buildings. The study concluded that the hospital buildings under study do not adequately comply with universal design principles. In conclusion, the study provided recommendations to improve the hospital's compliance with the universal design approach.

Keywords: Universal Design (UD), Sustainable Development Goals (SDGs), Healthy and Sustainable Environment, Pediatrics Hospital, Assiut University.

1- Introduction

The human needs of users vary according to the age, type, and physical and intellectual abilities of the user. The number of people with at least one disability worldwide continues to increase. Such increase is resulting from many factors; some of which are natural, and the other factors are caused by disasters, age, and the different standards of health care that people receive, where adopting new medical procedures reduces the number of people with different injuries (Talib et al., 2016).

Corresponding author*: E-mail address: engamiraesam@yahoo.com

The number of elderly people is increasing worldwide, and by 2050, 80% of them will live in low and middle-income countries (Hussein et al., 2024). In Egypt, the elderly population reached 6.40 million in 2018. The Egyptian government has taken steps to ensure the health, economic, social, cultural, and recreational rights of the elderly by issuing article (83) of the Egyptian Constitution of 2014(Hussein and Ali, 2021).

The World Health Organization (WHO) defines a disabled person as someone with a permanent or temporary physical or mental deficiency (Ghoshal, 2018). The number of elderly people is increasing globally, and by 2050, 80% of the elderly population will live in low and middle-income countries (Mitchell and Walker, 2020). In Egypt, the elderly population reached 6.40 million in 2018. The Egyptian government has issued article (83) of the Egyptian Constitution of 2014, which obligates the state to take care of the health, economic, social, cultural, and recreational rights of the elderly(Hussein et al., 2024).

The Egyptian Law No. 10 of 2018 on the Rights of Persons with Disabilities was enacted to ensure their full integration into society in all institutions and provide all services and facilities to them. The competent administrative authorities of planning and organization affairs, their affiliates, the ministry of local development and its affiliates are committed not to issue any licenses to the new buildings except for buildings that meet the requirements of the Egyptian code for the use of external spaces and buildings for persons with special needs, and to facilitate their use of public and private facilities and buildings. Hence the interest of the Egyptian State in this social group as an important group in society with rights and duties(M.Sand and Hassan, 2018) .

The United Nations Strategic Plan 2030 is firmly anchored in the principles of equality, non-discrimination and achieving quality of life and it is committed to "include everyone without exception", " reach the excluded persons first", and pay a special attention to marginalized groups (Wennersten and Qie, 2018).

In 2015, all United Nations Member States adopted the Sustainable Development Goals (SDGs) to mitigate inequality and build more peaceful and prosperous societies by 2030. It is a call for action to create a world where no one is neglected (UNICEF, 2023).

The said strategic plan devotes two goals to combat discrimination and inequality (Goal 5 on gender equality SDG5 and Goal 10 on the mitigation of inequality SDG10) along with its commitment to achieve a healthy life quality (Goal 3 on good health and welfare SDG3) (Wennersten and Qie, 2018).

The (WHO) and the American Planning Association (APA) are working towards making cities more "senior-friendly" by accommodating "aging in place." They have recognized that open spaces are vital to meeting the needs of older individuals and are attempting to comply with demographic changes in this regard (Ahmed, 2023a).

The essence of social sustainability and social inclusion work is to help people - regardless of gender, race, religion, age or disability to overcome obstacles that prevent their full participation in society, and to support their efforts to create their future (Kadir and Jamaludin, 2013).This is accomplished through working with governments, communities, civil society, the private sector and other relevant people to create societies that are more inclusive, empower citizens and encourage more resilient and peaceful communities (Carnemolla et al., 2021) .

The term Universal Design (UD) originated in America and began to be used by architect (Ronald Mace) in the second half of 1980. At first, the focus was on disability and the built

environment then the civil rights movement emerged, whose goal was to achieve equality and full enjoyment of services and products by all users. After that, the concept of UD spread across the world and has been practiced in various ways and in many fields. The American architect Ronald Mace defined (Universal Design) as: (creating places and products that, to the greatest extent feasible, can be used by everyone without the requirement for special design or adaptation). UD has inherent roots in the architecture field as it includes removing obstacles from the built environment for all users and meets the needs of building users and the surrounding built environment (Lidwell et al., 2010) .

UD aims to simplify life for all members of society by making the built environments and various products easy to access and handle with minimal effort and cost. It includes all age groups, different types, and varying abilities of people; thus, this design becomes an integral part of the architecture, design, and planning of the surrounding environment. Hence, we find that UD extends to accommodate everyone without customizing a specific design to a specific group of society or marginalizing a group of society(Erlandson, 2008) .

Moreover, the application of UD in creating living spaces and public environments that are suitable for everyone. UD contributes to achieving social sustainability by meeting new standards for [health and welfare, safety and security, access to facilities and comfort means, participation, and community interaction] (Hussein et al., 2024) .

The application of UD is characterized by taking into consideration not to divide society by setting classifications of its members as disabled people, the elderly, the sick, and so on. It aims to provide the needs of everyone without discrimination for some societal groups over others in order to ensure the general benefit for all people (Smith and E., 2011) .

As there is a global orientation towards achieving the sustainable development goals SDGs, and Egypt's Vision 2030 seeks to ensure a healthy life, promote wellness for everyone at all phases of life, and strengthen positive cultural values that respect diversity and variation (UNICEF. Data and Analytics Section, 2023) .

In this regard, the Universal Design approach (UD) and its principles seek to achieve the Sustainable Development Goals (SDGs), especially with regard to the Goals (SDG3 Good Health and Well-being, SDG5 Gender Equality, SDG10 Reduced Inequalities).

1.1 Statement of problem:

The building of Pediatrics Hospital at Assiut University -under study- lacks the application of UD standards as a facility with a large gathering of people of various ages and abilities. The lack of some of UD standards represents a deficiency in the core goal for which hospitals were established, which leads to the difficulty of using some spaces by the largest number of users. Furthermore, the lack of social awareness of the role and importance of UD negatively affect patients, doctors, and all hospital frequenters.

1.2 Objectives of the study:

The research aims to achieve an accessible therapeutic environment designed sustainably and inclusively that accommodates all users with various health conditions, ages, and physical abilities. The study seeks to promote the efficiency of these buildings under study to achieve convenience for the users inside, in addition to providing an optimal hospital environment that meets the psychological, social, and human needs of patients. To achieve the research objectives,

the building of the Pediatrics Hospital at Assiut University was examined, analyzed, and evaluated as a case study in light of the UD standards and its principles.

1.3 Significance of the study:

This research contributes to achieving inclusive hospitals in Egypt with the possibility of applying this outside of Egypt and achieving a therapeutic environment that is accessible, appropriate and convenient for all users, medical service providers and the treatment staff.

1.4 The importance of UD in healthcare facilities: (Baida and Ivanova, 2019)

Hospitals are one of the most important facilities of human gatherings points include doctors, nursing staff, administrators, other staff and patients of all ages and genders, some of whom cannot move and some live on medical devices. Therefore, hospitals are totally different from any other facility occupied by healthy people who can easily escape upon hearing the alarm bells or receiving news of a fire accident. They also contain hazardous substances such as chemicals and radioactive substances. Therefore, the maximum levels protection, safety, comfort and easy use of these facilities must be provided.

Despite the scientific and technical progress that have taken place in our society, and despite the advances in hospital buildings over the past few decades, there is still a problem for those who find difficulty in accessing health care services and in using those premises easily because of various health issues this a group of users.

The difficulties experienced are mainly related to the design and organization of those buildings, as the design shall be for everyone no matter how different and unique the person is, and, in practical terms, it provides access to the hospital and its services and helps to facilitate the accommodation of a person with hearing or vision impairment and helps the elderly to know directions and find out where he is going in an environment that is not familiar to him enabling to provide comfort in use for doctors, nurses and patients. All these are the goals that UD approach aims to achieve.

The study attempts to achieve sustainable health care facilities that include everyone, with easy access and use of all hospital spaces and services by all users of various physical abilities and ages.

One of the essential actions of non-discrimination is to provide the right for everybody to utilize diverse buildings easily, and independently. UD seeks to create usable, accessible, and easy buildings and environments for different ages, sizes, and abilities (Mustaquim, 2015).

Accordingly, embracing a UD as an approach to designing new buildings or developing existing ones is the best path to reach societal inclusion for all classes, thus, achieving a sustainable community. Applying UD standards creates safe buildings and environments that are usable, and accessible for all users, thus, improving the quality of life of all people (Ahmed, 2023b) .

UD seeks to create a society that recognizes human diversity, ensures equality and social inclusion, and enhance respect for the capabilities of every person. It works to improve the quality of life of all people with no one left behind, reduces stigma and discrimination, provides more opportunities for all groups, and promotes independence and social inclusion, which reduce the economic burden of special programs and services that aim at helping specific people and groups (Paik et al., 2014). It also recognizes the needs of all users in various fields, thus preventing future irrational expenditures of companies and governments, ultimately to make the world compelling, convenient, accessible and safe for all users (Garofolo, 2023) .

In this regard, **the importance of UD in healthcare buildings** becomes clear as follows:

- Promotes developing policies for medical facility and takes into consideration the needs of everyone who uses the facility such as clients and their families, and medical service providers.
- Saves resources.
- Reduces potential risks and provides a safe environment.
- Recognizes human diversity.
- Makes service providing all about human, ensuring safety, high quality and respect for human dignity.
- Enhances improvement of clients and employees' health.
- Provides solutions that can be modified or changed to meet the different needs and requirements of the users.
- Helps to balance the needs of different people.
- Reduces professional burnout for medical workers.
- Improves efforts and facilitates the work of employees.
- Enhances safety and comfort for everyone.

Accordingly, the beneficiaries of UD are as follows: (Baida and Ivanova, 2019)

UD takes into consideration the interests of: (Clients and healthy and sick people, medical worker, Family members and companions)

Since UD is for everyone, differences between humans shall be taken into consideration in terms of:

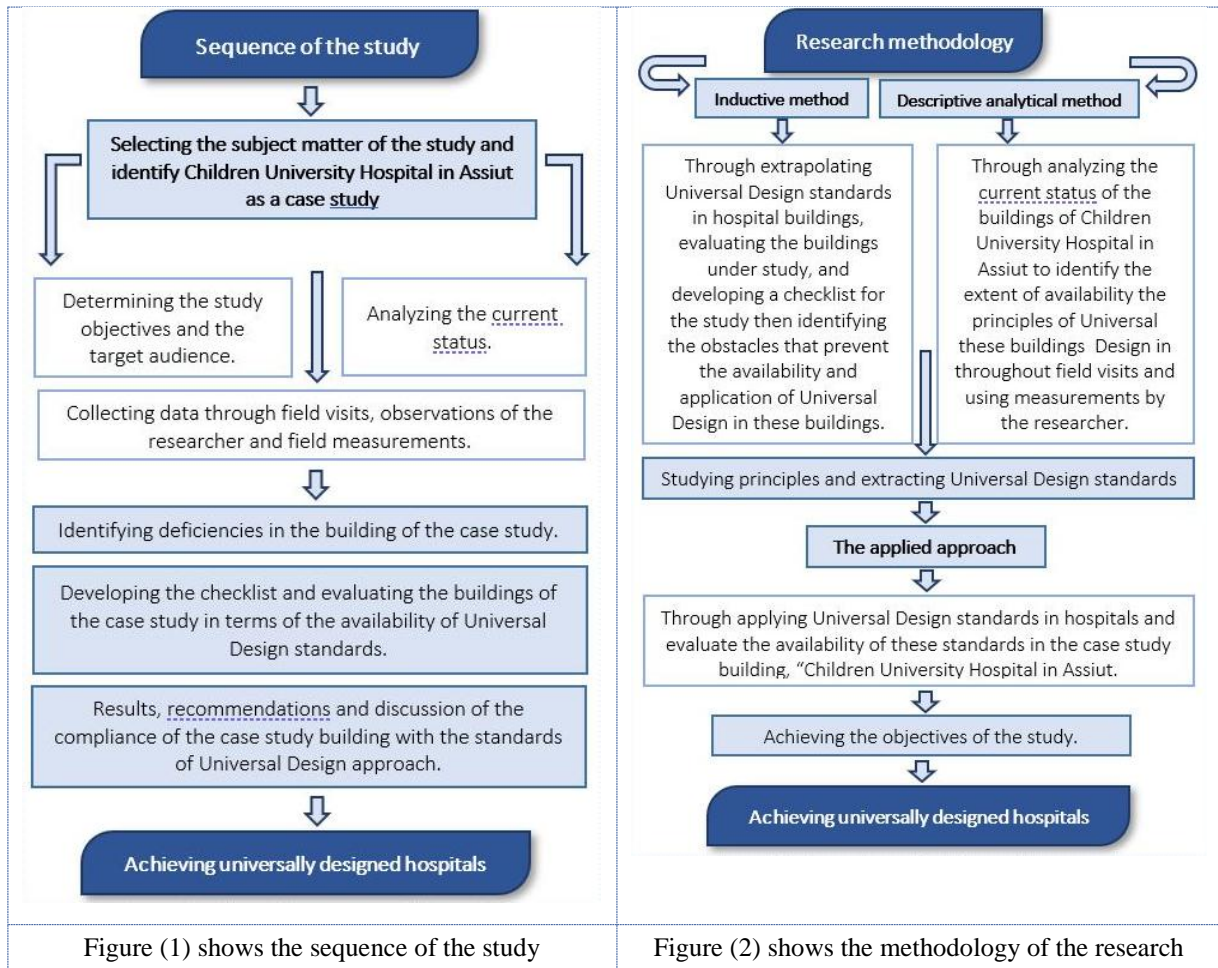
- Vision, Hearing, Movement, intellectual abilities and Communication abilities.
- Height, Weight, Age and Gender.
- Dietary preferences and restrictions, Culture, Religion, Social status and Economic status.
- Psychological and emotional state and Methods of perception

2. The Materials and Methods:

The study adopted several research methods such as:

- **Descriptive analytical method** through analyzing the current status of the buildings of Pediatrics Hospital in Assiut to identify the extent of availability of the principles of UD in these buildings throughout field visits and using measurements by the researcher.
- **Inductive method** to extrapolate UD standards in healthcare buildings such as hospitals. A checklist for this study was developed in light of the UD approach for public hospital buildings.
- **The applied approach** through applying UD standards and evaluating their availability in the case study building, "Assiut University Hospital - Children's Department" then identify the obstacles that prevent the application of UD approach and its principles.

Figure (1) and Figure (2) clearly reflect the sequence of research steps to achieve the objective of the study, as the building of the Pediatrics Hospital in Assiut was selected as the case study building. Data was collected and the target audience was determined through field visits and some observations by the researcher, after examining the principles of UD and extrapolating the standards of UD, an analysis of the current status was conducted and the deficiencies of the building that prevent the availability of UD principles were identified. An assessment was made for the availability of those standards and a checklist was developed for that study in light of UD approach in public hospitals. Some results were concluded and a discussion was taken place through which the objective of the research was achieved.



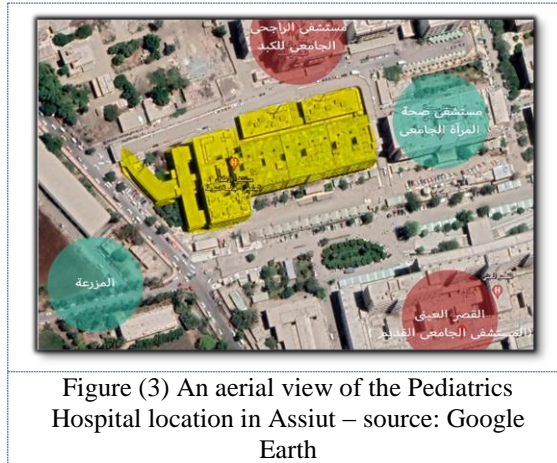
2.1 The case study (Pediatrics Hospital in Assiut) (Assiut University, 2020)

A. Description and location

Assiut University Hospitals are one of the largest educational and therapeutic university hospitals in Egypt (Mohamed et al., 2021). The Pediatrics Hospital was established on an area of 7,000 square meters and consists of a basement, ground floor, and five upper repetitive floors, with a total capacity exceeding 476 beds, including all medical specialties in the various branches of pediatrics and pediatric surgeries. It is the first specialized pediatric hospital in Upper Egypt, which was opened on Sunday corresponding to 25/07/2004 AD.

A.1 The Hospital Location

- It is bordered from the north by Al Rajhi University Liver Hospital, from the south by the Assiut University Hospitals (the old building - Al-Qasr Al-Ainy), from the east by Women's Health University Hospital, and from the west by the main road Al-Baisari road and the research farm of the Assiut University faculty of Agriculture, figure (3).
- It has two entrances, one of them on the main street - Al-Baisari Road, which is the same entrance to the emergency, ambulance, service and public, and another entrance from inside the university hospitals site.



It has four main movement batteries consisting of a staircase, two elevators, three main entrances to the building block, and four sub-entrances (Figure 4).



B. Medical and therapeutic services provided in the building of the case study

The hospital provides its medical services at various recognized medical levels in the field of health care including health services at the first, second and third advanced levels, through several sections such as: the emergency reception unit, the pediatric intensive care unit, the hematology unit, surgeries and laparoscopy ward, and newborn infants unit., Endocrine unit, nutrition unit, and surgical and radiology departments.

B.1 UD standards in health care buildings

Hospitals are a type of healthcare building as they are divided according to UD standards into three parts: (external areas, internal areas, spatial configuration and form of building) as shown in Figure (5).

This study focuses on analyzing and evaluating only the external areas of those three parts. The external areas are divided into (exterior routs, arrival and departure areas, outdoor amenities, external support systems, and other elements) as shown in Figure (6).

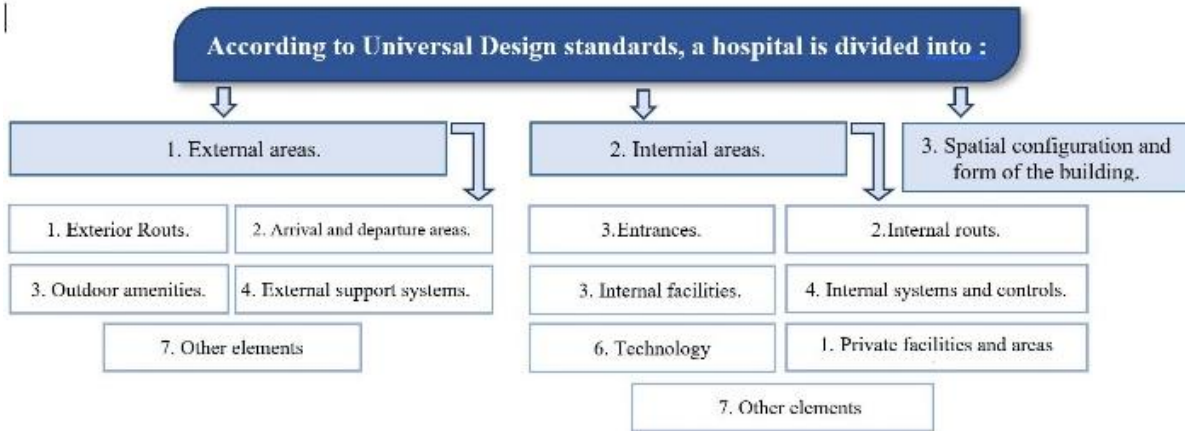


Figure (5) Sections of health care areas according to UD standards

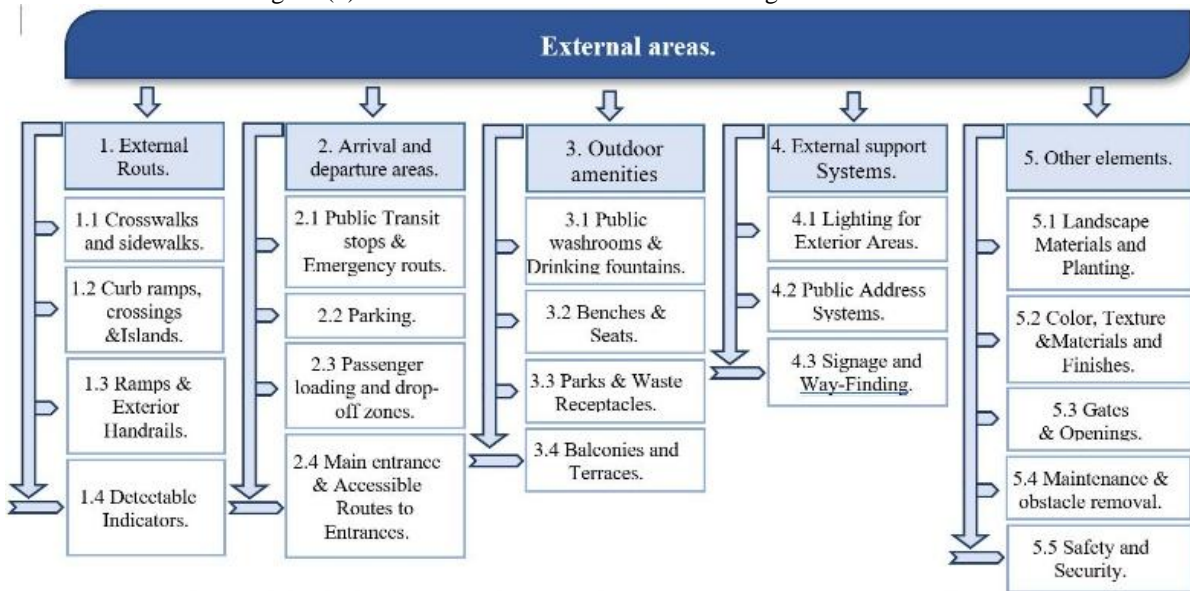


Figure (5) Grid of dividing the elements of external areas according to UD requirements

B.2 The Checklist according to UD requirements:

The checklist was developed according to the requirements of UD to evaluate the building of Pediatrics Hospital in Assiut under study. The extent to which the principles of UD were achieved was identified through the points obtained by the hospital under study, as shown in Table (1):

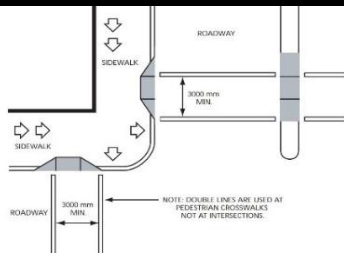
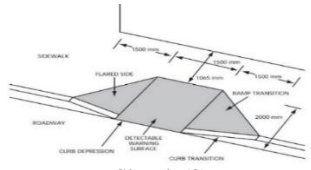
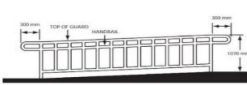
2.2 How far the principles of UD have been achieved at Pediatrics Hospital at Assiut University

Table (1) shows the evaluation degree of elements' compliance

Description	Points
Fully Achieved	3
Partially Achieved	2
Weakly Achieved (Not Achieved)	1

First: External Areas, which include (Exterior routes, arrival and departure areas, outdoor amenities, external support systems and other elements). The tables from (2) to (6) show the degree of each element's compliance with UD requirements

Table (2) shows the degree of compliance of exterior routes in external areas with the requirements of UD.

Exterior Routs		
1.1 Crosswalks and Sidewalks (Andy, 2014; Spiridon et al., 2018; Talib et al., 2016)	Degree of Achievement	Explanatory Sketch
<ul style="list-style-type: none"> The length of the path must not exceed 500 meters; the paths must be flat and level, with a minimum width of 1.525 meters, barrier-free, and non-slip, Figures (7). 	1	 <p>Sketch (1)</p>
<ul style="list-style-type: none"> Providing comfortable seats with back and arm rests every 100 m to 125 m. 	2	
<ul style="list-style-type: none"> Separating external crosswalks paths from emergency vehicles and service traffic, sketch (1). 	1	
<ul style="list-style-type: none"> Providing curb ramps in case of a difference in level exceeding 0.019 m. 	1	
<ul style="list-style-type: none"> Crosswalks paths must be at least 3 m wide marked with white lines, or with distinct highly contrasting paving materials. 	2	
<ul style="list-style-type: none"> Crosswalks paths located between crossings must include appropriate curb ramps at each end, with the crosswalks paths not placed at right angles to the sidewalk. 	1	
Degree of compliance with UD requirements out of "18"	8/18	44.44%
1.2 Curb ramps, Crossings, and Islands (Andy, 2014; Myerson and West, 2015; Spiridon et al., 2018; Talib et al., 2016)	Degree of Achievement	Explanatory Sketch
<ul style="list-style-type: none"> The maximum extension of the curbstone is 1:12 - 1:16. 	1	 <p>Sketch (2)</p>
<ul style="list-style-type: none"> Providing the curbstone with inclined side surfaces in places where pedestrians are expected to pass. The slope of the side incline ranges from 1:12 - 1:15, and the width of the curbstones (without the side incline) is not less than 1 m. 	1	
<ul style="list-style-type: none"> Providing a landing level with a width of 1.5 m and a depth of 1.065 m, sketch (2). 	1	
<ul style="list-style-type: none"> Providing stable, slip-resistant curbstones on both sides of the street with a moderate incline between the curb ramp and the ground adjacent to it, and providing them with detectable warning surfaces. 	1	
<ul style="list-style-type: none"> The detectable warning surfaces are made of materials of distinct color and texture that differ from the adjacent surfaces and extend across the entire width of the curbstone at a depth of 0.6-0.65 m. 	2	
<ul style="list-style-type: none"> Possibility of water draining and not accumulating at the bottom of the curbstone, and preventing establishing a curbstone in the corners. 	1	
<ul style="list-style-type: none"> The minimum level distance for walking before the highest point of the curbstone is 1.2 m.to enable pedestrians to avoid the curbstone 	1	
<ul style="list-style-type: none"> Traffic islands of materials and finishes that can be easily distinguished from the surrounding sidewalk, and the crosswalks paths that intersect between the traffic island of the public road and the main transit road have sidewalk ramps, sketch (3). 	1	
<ul style="list-style-type: none"> The minimum length of the level area between the curbstones on the traffic islands is 1.3 m, and the high traffic islands at crossings are leveled to match the street level. 	1	
<ul style="list-style-type: none"> As for flat islands adjacent to the street with a depth of more than 1.2 mm, they must be equipped with a distinct warning surface in a color contrasting with the adjacent sidewalks at 0.15-0.2 m away from the street, and 0.6-0.65 m deep. 	1	
Degree of compliance with UD requirements out of "24"	11/30	36.66%
1.3 Ramps and Exterior Handrails (Andy, 2014; Lidwell et al., 2010; Myerson and West, 2015; Spiridon et al., 2018; Talib et al., 2016)	Degree of Achievement	Explanatory Sketch
<ul style="list-style-type: none"> Avoid twisted designs of ramps, ensure that the start and end points are clearly visible, and the incline of the ramp ranges between 1:16 to 1:20, and the net width is 1 m. 	3	 <p>Sketch (4)</p>
<ul style="list-style-type: none"> The minimum width of the runway is 1.5 m and its minimum length is 2 m. 	1	
<ul style="list-style-type: none"> The minimum width of the runway if it leads to a door connected to a road equipped to facilitate access is 1.5*2 m (pull the door), 1.5*1.5 m (push the door). 	1	

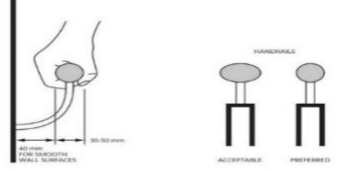
Exterior Routs		
<ul style="list-style-type: none"> A strip of a distinct color must be installed with the same width as the ramp and at a depth of (-0.01 / +0.05) m at the top and bottom of the ramp, where the level of incline changes at these two points, Figure (8). 	2	 <p>Sketch (5)</p>
<ul style="list-style-type: none"> Handrails must be installed on ramps between 0.86 m and 0.92 m, with a second lower handrail provided at a height of 0.65 m to 0.75 m from the upper surface above the ramp and landing surface, and the ends of the handrail must be turned or bent into an adjacent wall to assist people with vision disabilities. The level section of the handrail extends at least to 0.3 m beyond the upper and lower risers of all staircases or ramps, sketch (4). 	2	
<ul style="list-style-type: none"> The handrail must be of a smooth design easy to hold, its diameter should not exceed 0.03-0.04 m, and to use a degree of color so that the handrail is clearly highlighted from its background. It is preferable to use handrails fixed to the walls along the cross routes and on the sides of ramps and staircases, Figure (9), or where three or more steps are provided and it must be connected along the ramp or staircase and around the landing area to get support while walking, sketch (5) 	2	
Degree of compliance with UD requirements out of "18"	11/18	61.11%
1.4 Detectable Indicators (Andy, 2014)	Degree of Achievement	Explanatory Sketch
<ul style="list-style-type: none"> Detectable danger indicators contain signs that can be sensed including dome bumpers, installed at an appropriate height to be visible and do not cause pedestrians to stumble at the same time. Their diameter must be ± 0.035 m, and the top diameter must not exceed ± 0.025 m. Danger signs must be installed in a regular arrangement to prevent falling, and it is required that the edge of the danger sign to be at a distance of 0.06 to 0.65 m beyond the danger and a distance of 0.5 to 0.6 behind the danger. And it is necessary to take into consideration that the indicators should not expose the pedestrians to stumbling risk. 	2	
<ul style="list-style-type: none"> It is recommended that the detectable directional indicators have connected edges or patterns, and that the width of the detectable directional indicators be between 0.6-0.8 m, Figure (8). 	1	
<ul style="list-style-type: none"> Selecting the location of directional indicators in spacious and open spaces to provide people with the information necessary to identify the way, and placing detectable blocks close to crosswalks crossings outside buildings. The mobility of visually impaired people and their ability to know the direction can be improved by using detectable floor warning signs installed on surfaces of the floors and using materials of distinct colors and lighting that are easy to distinguish from its surroundings 	1	
Degree of compliance with UD requirements out of "9"	4/9	44.44%
Degree of all elements of Exterior routs compliance with UD requirements out of "75"	34/75	45.33%



Figure (7) Crosswalks, sidewalks, maintenance and obstacle removal policy. Source: the researcher 2023.



Figure (8) Detectable indicators, ramps and exterior handrails. Source: the researcher 2023.

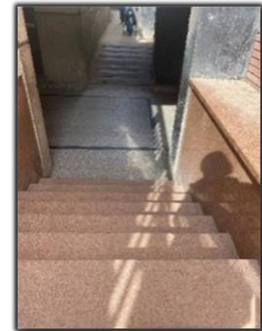
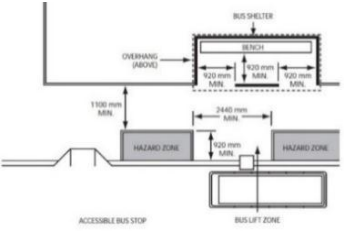
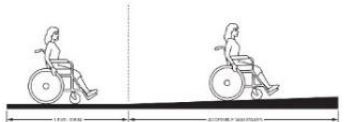


Figure (9) Ramps and exterior handrail. Source: the researcher 2023.

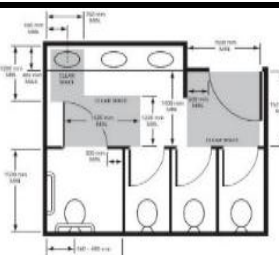
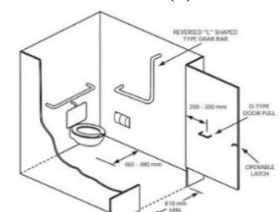
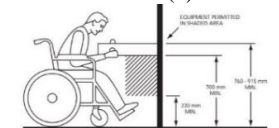
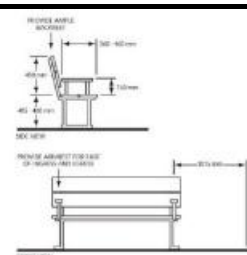
Table (3) shows the degree of compliance of arrival and departure areas in exterior areas with the requirements of UD.

Arrival and departure areas		
2.1 Bus/Public transit stops and emergency routes (Andy, 2014; Australia, 2014; Lavine, 2003)	Degree of Achievement	Explanatory Sketch
<ul style="list-style-type: none"> Bus stops must be located on a stable and level base of approximately 4,265 m x 1,830 m at the same height as the sidewalk or crosswalk. The clearance around the stop (especially on the side of the landing stand) must be at least 1.1 m, sketch (6). 	1	 <p>Sketch (6)</p>
<ul style="list-style-type: none"> The design of the bus stop must provide a clear view of oncoming traffic, with minimum internal length of 2.185 m to accommodate people who use movement aids. 	1	
<ul style="list-style-type: none"> At least one seat with a height between 0.405 m and 0.460 m must be provided inside the bus for the elderly and people with limited abilities. 	1	
<ul style="list-style-type: none"> All glass panels forming part of a bus shelter must have labels with a diameter of 0.05 m or a linked colored line installed at eye level of 1.525 m. Labels must be placed at a distance of no more than 0.15 m from the center, to ensure easy recognition. 	1	
<ul style="list-style-type: none"> Bus stopping areas must be clear of all street furniture. 	1	
<ul style="list-style-type: none"> Waiting areas at bus stops should be made of flat and stable materials with at least 2 m wide and 12 m long in order to accommodate waiting people. 	1	
<ul style="list-style-type: none"> Vehicle routes used by emergency vehicles (ambulances) must be clearly marked by proper signs. 	1	
<ul style="list-style-type: none"> Main Crosswalks transit into the main entrance or other accessible entrances should be avoided wherever possible. 	2	
Degree of compliance with UD requirements out of "18"	9/24	37.50%
2.2 Parking Lots (Andy, 2014; Lavine, 2003; Lidwell et al., 2010; Spiridon et al., 2018; Talib et al., 2016)	Degree of Achievement	Explanatory Sketch
<ul style="list-style-type: none"> Providing an accessible parking lot near to the entrance of the building. The circular routs adjacent to the parking lot that facilitate access shall form a part of the shortest passable route to the entrance of the building, taking into consideration ground surfaces requirements such as requirements for changing the level of height, gratings, bumps hazards, ceiling height and overhead hazards. Figure, (10). 	2	
<ul style="list-style-type: none"> Providing one parking lot for every 25 vehicles up to 100 vehicles, providing 5 parking lots for each yard that accommodates from 101 to 150 vehicles, providing 6 parking lots for each yard that accommodates from 150 to 200 vehicles, providing 7 parking lots for each yard that accommodates from 201 to 300 vehicles, providing 8 parking lots for each yard that accommodates from 301 to 400 vehicles, providing 9 parking lots for each yard that accommodates from 401 to 500 vehicles , and providing accessible parking lots at a rate of (2%) for parking lots that accommodate more than 500 vehicle. The number of accessible parking lots for each yard is more than 1,000. Vehicles (20 + 1 for every 100 vehicles or less over 1000 vehicles), the number of parking lots that facilitate access to each lot is more than 2000 vehicles (30 + 1 for every 100 or less over 2000). 	1	
<ul style="list-style-type: none"> The width of the accessible parking lot should not be less than 2.6 m, and it is required to provide a side passage of a 1.5 m. 	1	
<ul style="list-style-type: none"> The minimum dimensions of the parking lot in parallel lots including the side passage are 3.9m*7m. 	1	
<ul style="list-style-type: none"> The floor of the side parking lot is level and made of solid, stable, and slip-resistant materials, without being obstructed by sidewalk barriers or poles. Two adjacent parking lots may share a common side passage to facilitate access. 	1	
<ul style="list-style-type: none"> accessible parking lots and side passages shall be allocated for vans with a minimum dimension of 3.35 m * 5.50 m of van parking lot 	1	
<ul style="list-style-type: none"> The minimum width of the side passage adjacent to the van parking lot is 2 m. 	1	
<ul style="list-style-type: none"> The minimum depth of the back passage in the van parking lot is 2 m with a width of 2.6 m. 	1	
<ul style="list-style-type: none"> The minimum height allowed in the van parking lot along the route of vehicles is 2.75 m. 	1	
<ul style="list-style-type: none"> The minimum vacant space on the sidewalk adjacent to a parallel van parking lot is 2.44 m. 	1	
<ul style="list-style-type: none"> Each parking lot equipped to facilitate accessibility must be designated for people with physical disabilities, and the vertical sign installed in the parking lot should include the international code of accessibility with the international code of accessibility drawn on the floor in the middle of each parking lot. 	1	
<ul style="list-style-type: none"> A vertical sign should be installed on a wall or pole in front of the vehicles parking lot at a height of 1.5-2.5 m from the ground surface to the centerline. It is not allowed to use free installation beams for Signs installed in pedestrian areas. The minimum width and height of the sign is 0.3-0.45 m. 	1	
<ul style="list-style-type: none"> The minimum length of the international code of accessibility on the sidewalk is 1 m, and the color of the code should be distinct from the color of the sidewalk. 	1	

Arrival and departure areas		
<ul style="list-style-type: none"> As for ticket devices, displays should be provided for visual information with detectable and/or audible indicators, color differentiation should be taken into consideration, and the screen should be made of non-reflective materials. 	1	
<ul style="list-style-type: none"> A detectable warning indicator should be placed when the incline level is more than 1:3, and it should be fixed on a high edge not protected by a barrier where the difference in height is more than 0.25 m. It should be placed at the entrance to the vehicles route or in an area free of barriers or separating elements between vehicles route and pedestrian route. 	1	
Degree of compliance with UD requirements out of "45"	16/45	35.56%
2.3 Passenger loading and drop-off zones (Andy, 2014; Lavine, 2003; Lidwell et al., 2010; Smith and E., 2011)	Degree of Achievement	Explanatory Sketch
<ul style="list-style-type: none"> The minimum area of the transit passage that leads to the passenger loading area (width x length) is 1.5*6 m. 	1	
<ul style="list-style-type: none"> A crossing passage should be provided on the route parallel and adjacent to the pedestrian route, with it highlighted to prevent vehicles from parking in it. The crossing passage must be at the same level as the parking area, with curbstone between the crossing passage and the parking area. 	1	
<ul style="list-style-type: none"> If there is no barrier on the sidewalk between the vehicles area and the passenger drop-off area, the two areas should be separated by warning indicators with using barriers (poles). 	1	
<ul style="list-style-type: none"> Detectable warning indicators should be placed at the entrance to the vehicles route or vehicle parking lot if there is no barrier or element separates the vehicles route and the pedestrian route. 	1	
<ul style="list-style-type: none"> The minimum height of vertical space in passenger loading areas along vehicle routes is 2.75 m. 	1	
<ul style="list-style-type: none"> The minimum area of the sidewalk in the side loading area (width x length) is 2*2 m. 	1	
<ul style="list-style-type: none"> It is required to use barriers (poles) if the vehicles route is at the same height as the adjacent sidewalk. 	1	
<ul style="list-style-type: none"> The maximum cross slope in the loading area is 1:50. 	1	
<ul style="list-style-type: none"> Signage must indicate the specific uses and times of use. 	1	
<ul style="list-style-type: none"> A parasol should be used for protection from weather factors with providing good lighting in the passenger loading area. 	2	
Degree of compliance with UD requirements out of "30"	11/30	36.67%
2.4 The main entrance of the hospital and accessible routes to entrance (Andy, 2014; Commission, 2007)	Degree of Achievement	Explanatory Sketch
<ul style="list-style-type: none"> The hospital compound should create a quite space with careful use of plantings to create a therapeutic environment outside and inside the building in addition to creating visually distinctive entrance, which clearly identifies the main general access point, Figure (11). 	3	
<ul style="list-style-type: none"> Providing proper guidance for people in the hospital to find their way using clear, easy-to-read signage, distinct paths or routes, and recognizable visual signs such as building elements, artwork, or plantings, Figure (12). 	2	
<ul style="list-style-type: none"> Providing gathering and meeting zones to enhance guidance, creating rest points, providing protected and shaded seats with back and arm rests every 100 m to 125 m to provide users rest points and give them the opportunity to stop and orient themselves. 	1	
<ul style="list-style-type: none"> Provide a large covered space to create a transition area between indoors and outdoors providing shelter for someone coming out of the building to allow them to adapt to external conditions, figure (11). 	2	
<ul style="list-style-type: none"> Creating an entry yard or a similar public space adjacent to the main public access point, providing a transitional space between indoors and outdoors and providing gathering space for social interaction, figure (11). 	1	
<ul style="list-style-type: none"> Providing proper lighting, signage and clearly defined paths to guide people to and from the hospital entrance. 	2	
<ul style="list-style-type: none"> Providing an accessible route from the site boundaries to the main entrance and other entrances, it should not be less than 1.1m with a recommended width of 1.675m, and made of a solid anti-slip material. 	3	
<ul style="list-style-type: none"> Accessible Pedestrian routes to entrances must be designed so that they do not cross vehicle routes. 	1	
<ul style="list-style-type: none"> Providing crossings with proper barrier ramps identified by bright yellow or white lines and/or distinctive paving in cases where accessible pedestrian routes are crossed with vehicle routs, 	1	
<ul style="list-style-type: none"> Passage ramps should not exceed 1:20 (5%), and when steeper paths are needed, nearby staircases should be provided and the paths should be treated as ramps, Sketch (7). 	2	
<ul style="list-style-type: none"> When the length of routes that facilitate access to entrances exceeds 30 m, it is recommended 	1	
		 <p>Sketch (7)</p>

Arrival and departure areas		
to use rest zones at intervals of every 30 m.		
Rest zones should be located on one side of the passages, of at least 1.2m deep and include space for a seat or wheelchair.	1	
Degree of compliance with UD requirements out of "36"	20/36	55.56%
Degree of all elements of arrival and departure areas compliance with UD requirements out of "135"	56/135	41.48%

Table (4) shows the degree of compliance of outdoor amenities in exterior areas with the requirements of UD.

Outdoor amenities	Degree of Achievement	Explanatory Sketch
3.1 Public washrooms and Drinking fountains (Andy, 2014; Australia, 2014; Lidwell et al., 2010; Myerson and West, 2015; Snider and Takeda, 2008; Talib et al., 2016)		
Public washrooms for both sexes must be provided, and washrooms must be available to everyone.	1	 <p>Sketch (8)</p>  <p>Sketch (9)</p>  <p>Sketch (10)</p>
Providing sufficient space for movement in front of the washroom doors and providing a free space on the inner side of the washroom cabin door, taking into consideration not to place two doors in a row.	1	
As for the entrance to the washroom, the minimum vacant space in front of the washroom that is not equipped with a barrier at the entrance, with the longest side parallel to the entrance, is 0.92 * 1.525 m. The vacant space in front of the entrance to the washroom equipped with a barrier is not less than (depth x width) 0.92 * 1.525 m. The height of the barrier or threshold should be gradual. The incline must not exceed 1:2 (50%) in a height ranging between 0.0065-0.01 m, and the height of the washroom entrance barrier should not exceed 0.01 m with a width of 0.05 m, sketch (8).	1	
The minimum dimensions of the vacant space in the washroom equipped to facilitate the entry of carts are 1.5*1.5 m, and the floor must be resistant to slipping upon being wet. The minimum interior space is 1.7*1.8 m.	1	
Providing a washroom door with a clear width of at least 810mm and 1220mm vacant space in front of washroom doors to ensure accessibility, sketch (9).	1	
The height of the top part of the toilet from the ground is 0.46-0.48 m, the height of the flush control tools from the ground is 0.6-1.1 m, and the height of the horizontal anchor bar from the floor is 0.75-0.85 m.	1	
The tap on the sinks should be of the automatic type, and the maximum height of the water cup hanging from the plastic cup container is 1.2 m from the floor surface.	1	
Outdoor public drinking sinks should be provided and it must be installed tightly, ensure an empty area of the knee less than 700 mm to allow convenient access for people using movement aids. The tap height off ground should be 0.76-0.8 m, and control tools must be easy to operate with one hand, sketch (10).	1	
Degree of compliance with UD requirements out of "30"	8/24	33.33%
3.2 Benches and seats (Andy, 2014; "Kansai Rosai Hospital Garden UD Case Studies," n.d.; Lavine, 2003; Steinfeld and Maisel, 2012)		
Providing comfortable seats with back and arm rests every 100 m to 125 m.	2	 <p>Sketch (11)</p>
Armrests help the person get in and out of the seat while backrests provide additional support for convenience, sketch (11).	1	
Degree of compliance with UD requirements out of "6"	3/6	50%
3.3 Parks, public spaces, and waste receptacles (Andy, 2014; "Kansai Rosai Hospital Garden UD Case Studies," n.d.)		
	Degree of Achievement	Explanatory Sketch

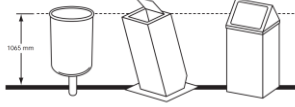
Outdoor amenities		
▪ The interior and exterior spaces of the hospital should be designed in a way that provides physical and visual access to the outdoors.	3	
▪ Providing direct access from main interior spaces such as the outpatient department through an accessible and easy-to-operate external door.	3	
▪ Using a canopied transition exterior space taking into consideration using of non-slip and non-reflective solid material for ground surfaces and avoiding sudden changes in ground finishes.	1	
▪ Avoid using elements that may cast ribbed shadows on the ground, as they may be perceived as changes in level.	3	
▪ Using colorful plantings or colorful materials for visual stimulation, using plantings that reflects the changing seasons, and providing plants that patients prefer (e.g. roses).	1	
▪ Cultivating aromatic plants to stimulate the sense of smell, and using bubble water features or anything like that for auditory stimulation.	1	
▪ Providing fencing using trees or long shrubs to block walls and fences. These plantings will help patients to reduce their sense of being trapped inside the hospital.	3	
▪ Waste receptacles and recycling bins must be accessible to people who use various movement aids and must be permanently located on one side of any path or passage so as not to trespass on the width of the walkway. They must be tightly fixed on fixed flat platforms in open areas.	2	<p style="text-align: center; font-size: small;">WASTE RECEPTACLES OF ALL TYPES SHOULD BE FIRMLY ANCHORED AND HAVE A SELF-CLOSING LID, WHICH IS EASY TO OPEN WITH ONE HAND</p>  <p style="text-align: center;">Sketch (12)</p>
▪ Waste receptacles in crowded places must be securely installed and be large enough.	2	
▪ Waste receptacles or stands containing waste containers must be clearly identified by appropriate signs and/or colors.	3	
▪ Providing covers on waste receptacles that should be easy to operate with one hand and installed at a distance not exceeding 1.065 m from the step, sketch (12).	2	
Degree of compliance with UD requirements out of “33”	24/33	
3.4 Balconies and Terraces (Andy, 2014)	Degree of Achievement	Explanatory Sketch
▪ Ensuring that the terraces are fully usable by people with different physical abilities. They must be easily accessible and visually accessible from main indoor spaces such as "patient wards."	3	
▪ The typical balcony with 1.2m high standard handrail may be appropriate in most cases.	1	
▪ Providing high safety glass of 1.8 m as a minimum or a balcony handrail.	1	
▪ Providing a balcony with a depth of 1.5 to 1.8 m as a minimum to serve as a suitable outdoor space. This may be especially important if a person spends most of his or her time in bed, Figure (13).	3	
Degree of compliance with UD requirements out of “12”	8/12	66.67%
Degree of all elements of outdoor amenities compliance with UD requirements out of “75”	43/75	57.33%



Figure (10) Parking lots, source: the researcher 2023.



Figure (11) signage, indicative symbols, the main entrance of the hospital, and access routes to entrances, gates and openings, source: the researcher 2023



Figure (12) the main entrance of the hospital and access routes to entrances, source: the researcher 2023



Figure (13): Balconies and terraces of rooms and green areas source: the researcher 2023.

Table (5) shows the degree of compliance of outdoor support systems with the requirements of UD.

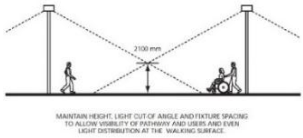
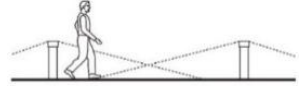
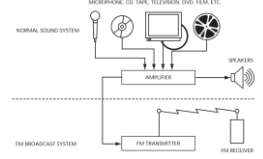
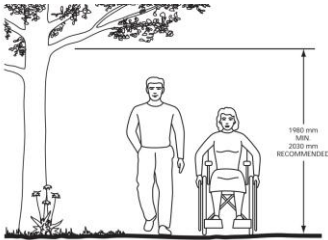



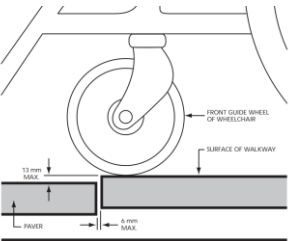
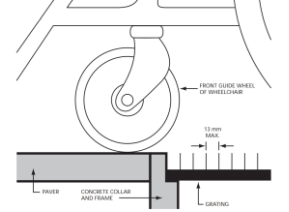
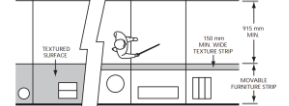
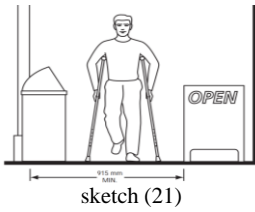
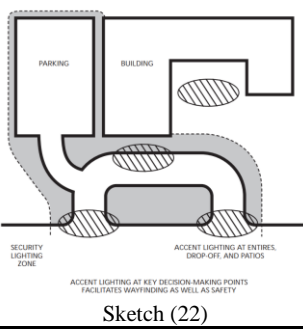
Outdoor support systems	Degree of Achievement	Explanatory Sketch
4.1 Lightening of exterior areas (not including roads) (Andy, 2014)		
<ul style="list-style-type: none"> Providing customized lighting in paths and entrances with selecting lighting sources and placing them on or next to steps and staircases to ensure clear identification of stairs, heights, and nosing. 	2	
<ul style="list-style-type: none"> Be cautious when using automatic lighting or sensor-activated lighting, as this may be startling or cause confusion. 	1	
<ul style="list-style-type: none"> Installing overhead lighting units to provide a clear overhead area of 2.030 m, below the lighting units. 	3	 <p>Sketch (13)</p>
<ul style="list-style-type: none"> External lighting should generally be designed according to the standards of I.E.S.N.A (Illuminating Engineering Society of North America) in all public roads and along crosswalks, sidewalks, bus stops or parking lots leading to public facilities. 	1	
<ul style="list-style-type: none"> All lighting must be distributed over crosswalks evenly providing an acceptable color range and reducing shadows. 	2	
<ul style="list-style-type: none"> Supplementary lighting should be provided to highlight all main road identification signs. 	1	
<ul style="list-style-type: none"> Lighting poles should be installed on one side of the crosswalks so as not to impede the movement of people using movement aids, and to ensure that they emit light upward to avoid glare, excessive reflection or shadows as this may cause confusion for some people, Sketch (13). 	2	 <p>Sketch (14)</p>
<ul style="list-style-type: none"> Ensuring that artificial lighting provides equal lighting along exterior paths with highlighting the main areas such as building entrances, staircases, and ramps, sketch (14). 	2	
Degree of compliance with UD requirements out of "24"	14/24	58.33%
4.2 Public address systems (Andy, 2014; Spiridon et al., 2018)		
<ul style="list-style-type: none"> Make every attempt to select and install systems that minimize jamming and provide a full range of sound, Sketch (15). 	1	 <p>Sketch (15)</p>
<ul style="list-style-type: none"> Speakers must be placed in a way that adequately cover the required area and ensure that the output is at acceptable levels to the public. 	1	
<ul style="list-style-type: none"> Upon announcing important information (such as emergency information), a clear warning signal should be provided before the announcement, to alert persons with hearing impairment. 	1	
Degree of compliance with UD requirements out of "9"	3/9	33.33%
4.3 Signage and way-finding (Andy, 2014; Lee and Kim, 2016; Myerson and West, 2015; Spiridon et al., 2018; Talib et al., 2016)		
<ul style="list-style-type: none"> Ensuring that the form and style used in any signage and banners is familiar with using a clear and large font and images in which the color of the font or image contrasts with the color of the background, figure (11). 	3	
<ul style="list-style-type: none"> Using matte finishes for all signage and banners in order to avoid glare. 	3	
<ul style="list-style-type: none"> Ensuring that the finishes are well lighted without causing excessive glare or reflection. 	2	
<ul style="list-style-type: none"> Ensuring that the language and terminology of the signs are easy to understand with the first letter of names and sites in capital letters and the rest of the word in lowercase letters, figure (11). 	3	
Degree of compliance with UD requirements out of "12"	11/12	91.67%
Degree of all elements of outdoor support systems compliance with UD requirements out of "45"	28/45	62.22%

Table (6) shows the degree of compliance of other elements in exterior areas with the requirements of UD.

Other elements	Degree of Achievement	Explanatory Sketch	
5.1 Landscape Materials and Planting (Andy, 2014; “Kansai Rosai Hospital Garden UD Case Studies,” n.d.)	Degree of Achievement	Explanatory Sketch	
<ul style="list-style-type: none"> Using familiar plantings and creating a quiet and soothing environment with careful use of plantings to produce a therapeutic environment indoors and outdoors. 	3	 <p style="text-align: center;">Sketch (16)</p>	
<ul style="list-style-type: none"> Use colorful and distinct plantings at locations and destinations to create visual landmarks to help in finding the way. 	2		
<ul style="list-style-type: none"> Use aromatic plantings to enhance wayfinding by providing scents at specific main locations such as entrances or crossings along paths, with avoiding planting with scents that irritate the skin or toxic plantings. 	1		
<ul style="list-style-type: none"> Ensuring that planting do not cause excessive shadows on the ground which causes difficulties for people, sketch (16). 	3		
<ul style="list-style-type: none"> It is preferable to avoid trees that drop fruit or excess leaves so that they do not cause slipping or stumbling along the paths. and in order to keep the paths clean. 	3		
Degree of compliance with UD requirements out of “15”		12/15	
5.2 Color, Texture, Materials and Finishes (Andy, 2014; Lee and Kim, 2016; Myerson and West, 2015; Steinfeld and Maisel, 2012; Talib et al., 2016)	Degree of Achievement	explanatory Sketch	
<ul style="list-style-type: none"> Using color intensity and contrast in exterior color schemes with adjacent colors (e.g. to define the boundaries of objects or to distinguish letters from a background color) in order to distinguish one surface from another, or to highlight certain objects from their backgrounds and to define the edges or boundaries of objects (e.g. stair nosing, handrails). 	1	   <p style="text-align: center;">Sketch (17)</p>  <p style="text-align: center;">Sketch (18)</p>  <p style="text-align: center;">Sketch (19)</p>  <p style="text-align: center;">Sketch (20)</p>	
<ul style="list-style-type: none"> For the elderly and people with impaired vision, colors at the warm end of the spectrum (i.e. yellow, orange and bright red) can be identified more easily than those at the cold end of the spectrum. 	1		
<ul style="list-style-type: none"> Using highly clear and contrasting colors for signage design by a percentage of approximately 70% (for example, white or yellow on a black background), and they also should be matte. Unacceptable background colors are light gray or pastel. 	3		
<ul style="list-style-type: none"> Using color in providing constant information (for example, the location of exit doors by painting all exit doors with the same distinctive color) 	1		
<ul style="list-style-type: none"> Using decorated surfaces as detectable alarm devices that are clearly distinguished from surrounding surfaces in order to give a signal to people with visual impairments that a potential danger is nearby, and all decorations should be matte to avoid glare, sketch (17). 	1		
<ul style="list-style-type: none"> A constant texture should be used to indicate hazards throughout a single location, sketches (18, 19, and 20). 	1		
<ul style="list-style-type: none"> Using colors in the blue and green zone of the color spectrum in order to increase clarity, in contrast to yellow and red colors, as these colors may be difficult to distinguish for people with dementia. 	1		
<ul style="list-style-type: none"> Painting the doors with a contrasting color with the wall to make them visually stand out from the background, painting the door frames with colors that contrast with the walls and ceilings to ensure a clear contrast between the floor finishes and the walls, ensuring that the door handle and the lock are finished with a color that stands out from the door, and reducing or removing the interior door thresholds that may be misunderstood as steps. 	2		
<ul style="list-style-type: none"> Using color contrast or color tone to highlight handrails, light switches, fixtures mounted on walls, and other important things that should be visually prominent. 	2		
<ul style="list-style-type: none"> Avoid sharp colors or color contrasts on floor finishes as they may be misconceived as a step. 	3		
<ul style="list-style-type: none"> Use color or decor to distinguish one room from another as part of the design strategy to create distinct spaces. 	1		
<ul style="list-style-type: none"> When selecting paints, low-gloss paints should be selected, shiny finishes with excessive reflection should be avoided, and materials with matte finishes should be used. 	3		
<ul style="list-style-type: none"> Condensation on mirrors causes problems for people with dementia, so it is preferable to install heated mirror pads to keep mirrors steam free, and ensuring that all mirrors can be easily moved, removed or covered. 	1		
<ul style="list-style-type: none"> All ramp surfaces must be solid and non-slip. Handrails must be continuous, smooth and easy to maintain, and walls adjacent to ramps or stairs must have non-abrasive finishes 	3		
Degree of compliance with UD requirements out of “42”			24/42
			57.14%

Other elements		
5.3 Gates and openings (Andy, 2014; Lidwell et al., 2010; Myerson and West, 2015; Spiridon et al., 2018)	Degree of Achievement	Explanatory Sketch
▪ Interior doors should be installed so that they open to the adjacent wall to allow maximum views of the room from adjacent spaces upon opening the door.	2	
▪ For non-fire resistant doors, using a door unlocking device to keep the door fully opened must be taken in consideration in order to maintain visual access.	1	
▪ Using additional wide doors or door and a half to provide maximum physical access in addition to a proper visual access.	2	
▪ Painting the doors in a contrasting color with the wall to make them visibly stand out from the background, and ensuring that the door handle and any lock is finished in a distinctive color from the door, figure (11).	2	
▪ Ensuring that the window sill heights and window edges do not block vision outside for anyone when sitting or lying in bed.	1	
▪ Providing windows that reduce glare and sound transmission with balancing solar heat gains with internal heat losses	2	
▪ Providing gates or openings through fences to access outdoor public use areas, and to have these openings available and of a minimum width of 0.915 m. The gate devices must be appropriate for independent use.	2	
Degree of compliance with UD requirements out of "21"	12/21	57.14%
5.4 Maintenance and Obstacle Removal (Andy, 2014; Myerson and West, 2015; Null, 2017; Smith and E., 2011)	Degree of Achievement	Explanatory Sketch
▪ All active crosswalks must be well maintained and all garbage containers emptied on a regular basis to avoid the accumulation of garbage around the containers or any other obstacles, sketch (21), figures (7, 8 and 9).	2	 <p>sketch (21)</p>
▪ All lighting lamps along crosswalks must be replaced according to a regular schedule with lamps of the same wattage.	1	
▪ All gates, door closers, automatic door operators, balcony elevators, automatic ticket machines or other essential equipment must be inspected and well maintained according to a regular schedule.	1	
Degree of compliance with UD requirements out of "9"	4/9	44.44%
5.5 Safety and Security (Andy, 2014; Lidwell et al., 2010; Myerson and West, 2015)	Degree of Achievement	Explanatory Sketch
▪ Ensuring that there is sufficient lighting across public passages, steps and ramps, as well as in places of public parking, sketch (22).	2	 <p>Sketch (22)</p>
▪ Crosswalks must be designed in a way that provide clear sight lines to ensure personal safety (Figure 10).	2	
▪ Providing a communication bell or a two-way communication device at the main accessible entrance, and in public parking lots, with the inclusion of appropriate two-way call system or emergency call system linked to both genders accessible washrooms in the hospital.	1	
▪ Providing an accessible public telephone at or near the main entrance.	1	
▪ Considering the use of personal alarms, providing a clearly visible and accessible two-way voice communication system, and a central monitoring location to receive such calls.	1	
▪ Developing a comprehensive "emergency plan" that meets people's needs to get out of facilities to outdoors or other places where crowd control is likely to be a problem.	1	
Degree of compliance with UD requirements out of "21"	8/18	44.44%
Degree of other elements compliance with UD requirements out of "105"	60/105	57.14%
Degree of Exterior areas compliance with UD requirements out of "435"	221/435	
Building compliance with UD		50.80%

3. Results and Discussion:

It turns out through the study and research that the hospital under study has achieved inclusiveness by 50.80%, figure (14). This means that the hospital has achieved some comprehensive design standards and lacked many other standards to comply with the requirements of UD and substantially achieves inclusiveness in a way that fits all users. The study

and the checklist show that the building is not sufficiently complied with the requirements of UD to provide inclusiveness for everyone, as the building achieved 50.80% as a compliance percentage to the principles of UD approach for exterior areas, figure (15).

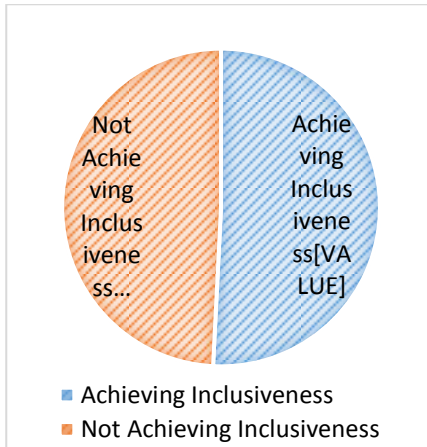


Figure (14) shows the degree of the building compliance with UD requirements.

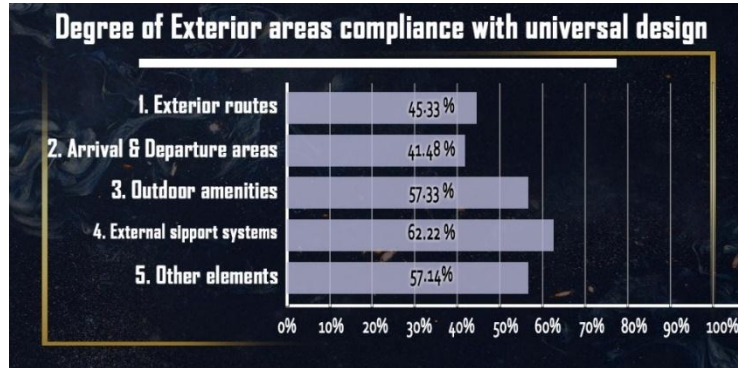


Figure (15) shows the degree of compliance of Exterior areas elements with UD requirements.

After detailed analysis, we found that the elements that most fulfill the principles of UD are (parks, public spaces, waste receptacles, signage, directional symbols, way finding, and green areas) with a compliance percentage of more than 70%. The least elements are (sidewalk ramps, crossings, islands, bus stops, emergency roads, public washrooms, drinking water elements, and public address systems) with a percentage of less than 35%, due to the absence of most of them and the lack of UD principles in them, as in (Figures 16, 17, 18, 19, 20).

This resulted in the exclusion of several groups of people from benefiting from the services of that building, therefore, it is necessary to reconsider many elements of the building to improve its usability for all users, in order to ensure community integration, support social sustainability, and to achieve some of the sustainable development goals adopted by the United Nations, Which is a global call to action to ensure that the population has equal access to services, quality of life, health and welfare, and achieve peace and prosperity everywhere.

By achieving these goals, we will reach a sustainable building that fulfills the equitable use for everyone and achieve the principles of UD and sustainable development goals.

Through further detailed analysis of the elements, we found that the external support systems got the highest degree in the external areas in terms of achieving inclusiveness, with a percentage of 62.22%, where signage, directional symbols, and wayfinding had the highest degree, with a percentage of 91.67%, followed by lighting in exterior areas with a percentage of 58.33%, then Public Address Systems with a percentage of 33.33% , figure (16).

The other elements came in second place in terms of meeting UD requirements, with a percentage of 56.48% in achieving inclusiveness. Landscape got the highest degree with a percentage of 80%, followed by color, materials and finishes, as well as gates and openings, both of which got 57.14%, while the maintenance and obstacles removal policy got a percentage of 44.44%, despite the importance of this element, it did not comply with the UD requirements and lacked many of such requirements. Safety and security got the lowest degree among the other elements, with a percentage of 42.86% , figure (17).

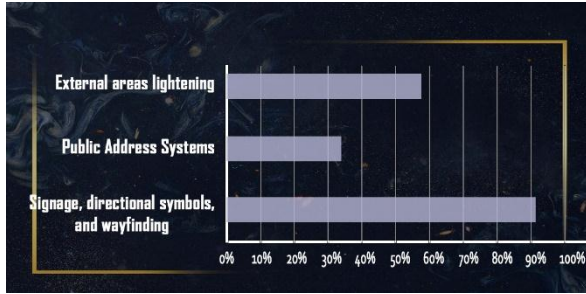


Figure (16) shows External support system.

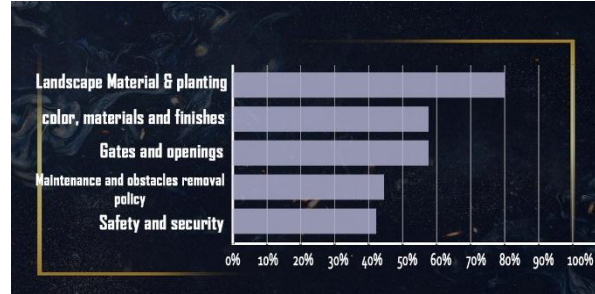


Figure (17) shows Other External Elements.

Outdoor amenities came in third place, with a percentage of 55.56% as a percentage of compliance with UD requirements in external areas. Parks and public spaces got the highest degree with a percentage of 72.73%, followed by room balconies and terraces, which got 66.67%. Seating and waiting areas got 50%, and the lowest degree in meeting UD requirements in outdoor amenities, are public washrooms and drinking fountains, with a percentage of 33.33%, as it lacks many principles of UD, which greatly affected the building's compliance and achieving inclusiveness in general, figure (18).

As for the exterior routes and arrival and departure areas, they got the lowest degrees in terms of evaluations. The exterior routes got 44.92% of achieving inclusiveness, ramps and exterior handrails got a percentage of up to 61.11%, followed by crosswalks and sidewalks, as well as detectable indicators, as they both got a percentage of 44.44%. Curb ramps, crossings and islands got the lowest percentage of 33.33%, figure (19).

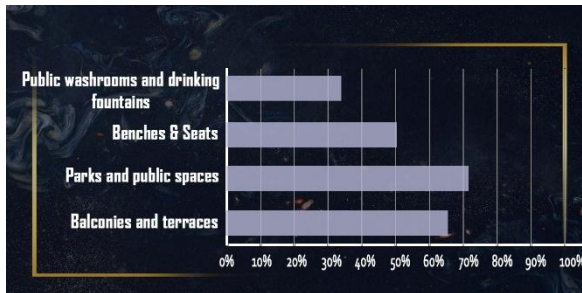


Figure (18) shows Outdoor Amenities.

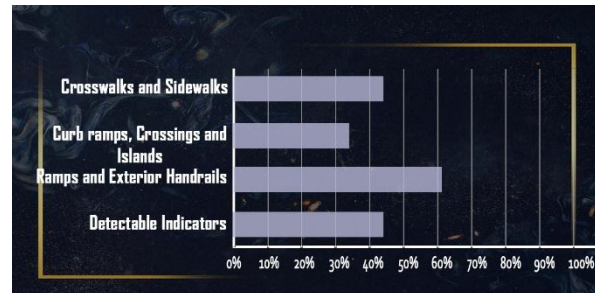


Figure (19) shows Exterior Routes.

Arrival and departure areas came at the bottom of the evaluations, as they got a lower degree than the other elements in the exterior areas. The main entrance of the hospital and the accessible routes to the entrances got a percentage of 55.56%, although it is the most important element in

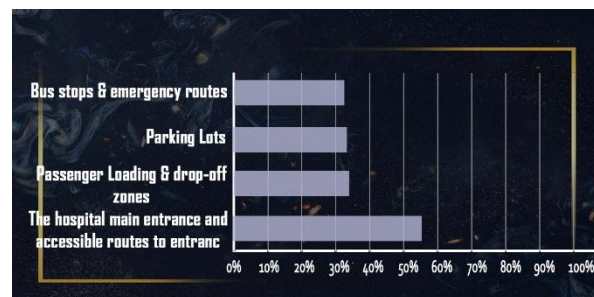


Figure (20) shows Arrival and Departure Areas.

terms of access to the hospital entrance, it is followed by passenger loading and drop-off areas with a percentage of 36.67%, as they lacked the requirements of the UD. Parking lots got a percentage of 35.56%, and the bus stops and emergency routes got a percentage of 33.33%. Thus, the element of the arrival and departure areas got a percentage of 41.09% of compliance with the requirements of UD, it is the least

element in terms of achieving inclusiveness, in addition to being the most lacking element of the requirements of UD, figure (20).

4. Recommendations:

Creating inclusive usable healthcare environments and services including all groups of society is an important element that benefits all users. Also, examining codes and standards of UD is a starting point in meeting the needs and goals of users, and promoting a healthy environment that accommodates everyone in the health care facility.

By examining and analyzing previous results, a range of problems with the accessibility and usability of the building have been identified in Table (7), and categorized as follows:

- In terms of the location of the element in the exterior areas.
- In terms of the possibility of solving the problem: (easy – moderate- difficult).

Then the proposed modification to solve the problem.

Table (7) shows the proposed modification to the building to become more compliant with the requirements of UD

	The Problem	Possibility of solving			The Proposed Solutions
		Easy	Moderate	Difficult	
Exterior Routes	Crosswalks and Sidewalks		#		<ul style="list-style-type: none"> ▪ Rehabilitating sidewalks to comply with the requirements of the UD
	Curb Ramps, Crossings, and islands		#		<ul style="list-style-type: none"> ▪ Establishing new curb ramps that comply with the requirements of UD whenever possible.
	Ramps and exterior Handrails	#			<ul style="list-style-type: none"> ▪ Modifying the design of the handrail and its ends according to the requirements of UD.
	Detectable Indicators		#		<ul style="list-style-type: none"> ▪ Providing a tactile floor for visually impaired people.
Arrival and Departure Areas	Bus stops and emergency routes			#	<ul style="list-style-type: none"> ▪ The site area does not allow modification.
	Parking lots			#	<ul style="list-style-type: none"> ▪ The site area does not allow modification.
	Passenger loading and drop-off areas			#	<ul style="list-style-type: none"> ▪ The site area does not allow modification.
	Main entrance of the hospital and accessible routes to		#		<ul style="list-style-type: none"> ▪ Providing seats and rest points to the hospital's entrance.
Outdoor Amenities	Public washrooms and drinking fountains				<ul style="list-style-type: none"> ▪ Providing public washrooms and public drinking sinks according to the requirements of UD.
	Seats and Benches	#			<ul style="list-style-type: none"> ▪ Providing canopy benches with back and armrests to allow the person to sit while waiting for his companion or to take a rest before or after entering the building.
	Parks, public spaces, and waste receptacles	#			<ul style="list-style-type: none"> ▪ Using a canopied transitional outdoor space to provide shelter that allows people to sit outside without being fully exposed to weather conditions. ▪ Providing plantings that patients prefer (such as roses). ▪ Using plantings that reflects the changing seasons. ▪ Using colorful plantings or colorful materials for visual stimulation ▪ Cultivating aromatic plants to stimulate the sense of smell, and using bubble water features or anything like that for auditory stimulation. ▪ Differentiating waste receptacles with distinct colors, fixing and covering them tightly, and constantly emptying them.
	Balconies and Terraces		#		<ul style="list-style-type: none"> ▪ Providing balconies with high safety glass of 1800 m as a minimum or a balcony handrail.
Outdoor support systems	Lightening of exterior areas	#			<ul style="list-style-type: none"> ▪ Selecting lighting sources and placing them on or next to steps and staircases to ensure clear identification of stairs, heights, and nosing. ▪ Distributing lighting over crosswalks evenly, providing an acceptable color range and reducing shadows for the safety of people with visual impairment. ▪ Providing Supplementary lighting to highlight all main road

	The Problem	Possibility of solving			The Proposed Solutions
		Easy	Moderate	Difficult	
					identification signs.
	Public address systems	#			<ul style="list-style-type: none"> ▪ Using a proper guidance system. ▪ Making every attempt to select and install systems that minimize jamming and provide a full range of sound. ▪ Upon announcing important information (such as emergency information), a clear warning signal should be provided before the announcement, to alert persons with hearing impairment.
Other Elements	Green areas				<ul style="list-style-type: none"> ▪ Using colorful and distinct plantings in locations and destinations in order to create visual landmarks that help in wayfinding. ▪ In conformity with creating visual landmarks, it is preferable to use aromatic plantings for promoting wayfinding by providing scents in specific main locations such as entrances and crossings along the paths.
	Color, Materials and Finishes	#			<ul style="list-style-type: none"> ▪ For the elderly and people with impaired vision, colors at the warm end of the spectrum (i.e. yellow, orange and bright red) can be identified more easily than those at the cold end of the spectrum. ▪ Using color contrast to define the edges or boundaries of objects (e.g. stair nosing, top and bottom of escalator and handrails). ▪ Using decorated surfaces to give a signal to people with visual impairments that there is a nearby potential danger. ▪ All decorated surfaces used as detectable alarm devices must be clearly distinguished from surrounding surfaces. ▪ Using constant texture be to indicate hazards throughout a single location. ▪ Using color or decor to distinguish one room from another as part of the design strategy to create distinct spaces. ▪ Ensuring that all mirrors can be easily moved, removed or covered. ▪ installing heated mirror pads to keep mirrors steam free,
	Gates and openings	#			<ul style="list-style-type: none"> ▪ For non-fire resistant doors, using a door unlocking device to keep the door fully opened must be taken in consideration in order to maintain visual access. ▪ Ensuring that the window sill heights and window edges do not block vision outside for anyone when sitting or lying in bed.
	Maintenance and Obstacle Removal	#			<ul style="list-style-type: none"> ▪ All lighting lamps along crosswalks must be replaced according to a regular schedule with lamps of the same wattage. ▪ All gates, door closers, automatic door operators, balcony elevators, automatic ticket machines or other essential equipment must be inspected and well maintained according to a regular schedule. ▪ Conducting regular and systematic inspections to ensure that there are no obstacles in crosswalks (for example, waste receptacles).
	Safety and Security	#			<ul style="list-style-type: none"> ▪ Providing a communication bell or a two-way communication device at the main accessible entrance, and in public parking lots. ▪ Providing an accessible public telephone at or near the main entrance for people who need urgent help. ▪ Considering the use of personal alarms, or providing a clearly visible and accessible two-way voice communication system (for example in places where people with disabilities or the elderly are likely gather and a central monitoring location to receive such calls. ▪ Inclusion of appropriate two-way call system or emergency call system linked to both genders accessible washrooms in the hospital. ▪ Developing a comprehensive "emergency plan" that meets people's needs to get out of facilities to outdoors or other places where crowd control is likely to be a problem.

From the proceeding, we find that the research seeks to raise the efficiency of building usability by everyone by providing UD standards and principles that facilitate access and use of all hospital buildings, facilities, and services. In addition to raising the level of public awareness of UD in

hospital and healthcare buildings, through a set of recommendations that make it possible to achieve inclusive hospital buildings for all users:

- The importance of conducting analytical studies of buildings in order to improve the performance of services in them, in accordance with the requirements of the UD.
- Taking into consideration during the design process the possibility of allowing everyone to use the building without discrimination.
- Adopting the principles of UD in designing the exterior routes and spaces of healthcare buildings.
- Designing entrances, stairs, and ramps in accordance with UD guidelines.
- Emphasizing applying the proper dimensions of the widths of the corridors and the inclines of the ramps and verifying their usability for people with disabilities and all users.
- Ensuring periodic maintenance of security and fire safety systems.
- Providing arrival and departure areas that meet the requirements of UD to achieve convenience and safety for the building users.
- Implementing modifications to existing hospitals to suit the needs of all users by following UD approach and principles.
- Working on executing the proposed modifications to improve accessibility and usability of the case study building.
- Scaling up scientific research to find solutions that make it easier for designers to follow UD as a design approach.
- The study proposes to restructure and develop the Egyptian sustainability assessment system (Green Pyramid), so that it becomes an integrated system for evaluating inclusiveness and sustainability in healthcare buildings.
- The competent official authorities conduct the necessary research and studies to develop a clear methodology, terms, and points of the proposals to develop the Egyptian evaluation system to be a system for evaluating inclusiveness and sustainability.
- Working on raising awareness of the concept of UD, its importance, and its impact on the functional performance of buildings.
- Educating designers and architects about the necessity of paying attention to the needs and requirements of everyone during the design process and calling them to apply UD when designing and constructing hospitals in the future.
- To conclude, architects and designers should be educated about the role of UD and its criteria as a first step towards achieving inclusive environments for all, and thus, achieving social sustainability and community integration.

5. Conclusions

Universal Design (UD) is an approach to creating products and environments that can be used by all individuals, without the need for modification or specialized design. It is not a privilege or luxury for certain places or communities. This study focuses on the application of UD principles to hospital buildings, specifically Assiut University Children's Hospital. The aim of the research is to evaluate the extent to which the hospital aligns with UD requirements and principles, and to recognize that universally designed constructions are crucial for ensuring social integration and sustainability. The study analyzed various elements of the hospital building, and the results showed that it did not adequately meet the concept and principles of UD. The researchers and

building users agreed on the findings. Therefore, the study recommends making improvements to the building elements to ensure that it is inclusive and easy to use for all users.

List of Abbreviations:

UD: Universal Design.

ATM: The Automated Teller Machine.

Declarations:

Availability of data and materials: All data analyzed during this study are included in this submitted article

Competing interests: The authors declare that they have no competing interests

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Authors' contributions: **ME** analyzed and interpreted the data regarding the study buildings. **NA** collected the data and photographic documentation. **EA** was a major contributor in writing the manuscript. All authors read and approved the final manuscript.

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