

الآية

قال تعالى :

(امن الرسول بما انزل اليه من ربه والمؤمنون كل امن بالله وملائكته وكتبه ورسله لا يفرق بين احد من رسله وقالوا سمعنا واطعنا تخفوا انك ربنا واليك المصير لا يكلفه الله نفعا الا وسعها لها ما كسبت وعليها ما اكتسبت ربنا لا تؤاخذنا ان نسينا او اخطانا ربنا ولا تحمل علينا اصرا كما حملته على الذين من قبلنا ربنا ولا تحملنا ما لا طاقة لنا به واعف عنا واغفر لنا وارحمنا انك مولانا فانصرنا على القوم الكافرين).

الإهداء

الي الوالدة الغالية

الوالد العزيز

الأخوان

والأصدقاء

الي كافة احبائي...

الشكر والعرفان

الحمد لله رب العالمين والصلاة والسلام علي رسول الله الكريم الذي لولاه لما تعلمنا علما ينتفع به الي يوم الدين ومن لا يشكر الناس لا يشكر الله. فالشكر كل الشكر والتقدير للأب والمعلم الروحي د.الياس الصديق عميد كلية الهندسه لجامعة المستقبل تلك الشخصية الفذه التي لولاه لما اكتمل المشروع للصورة الكاملة عن طريق تقديمه لنا كل طرق النصائح والارشادات منذ ان كان هذا المشروع مجرد فكرة ووضعنا في الطريق الصحيح لنجاح هذا المشروع والشكر والعرفان للاسره الكريمة التي امدتنا بكل وسائل العون المادي والمعنوي.

واخيرا الشكر للباشمهندس سيف الدين محمد قسم السيد والمهندس محمد احمد محمد شانتير والمهندس عبدالحليم ناصر عبدالحليم بتقديمهم يد العون والمساعدة.

ABSTRACT

Emergency department is one of the most important sections of the hospital and the most difficult as a result of the reception of different situations in critical situations and the diagnosis of the situation quickly and work on the stability and for this important importance we have developed an ideal design for the emergency hospital on the basis of international standards and standards in terms of areas and sections and devices and functional relationship between each section and rehabilitation staff Medical to provide integrated health care for each patient and reduce the percentage of deaths due to negligence and lack of readiness for all the full cases

المستخلص

قسم الطوارئ يعد من اهم اقسام المستشفى واكثرها صعوبه نتيجه للاستقبال حالات مختلفه في اوضاع حرجه ويتم فيه تشخيص الحاله بسرعه والعمل علي استقرارها ولتلك الاهميه الكبيره قمنا بوضع تصميم مثالي للمستشفى الطوارئ علي حسب الاسس والمقاييس العالميه من حيث المساحات والاقسام والاجهزه والعلاقه الوظيفيه بين كل قسم وتاهيل الكادر الطبي لتقديم الرعايه الصحيه المتكامله لكل مريض وتقليل نسبه الوفيات نتيجه للاهمال وعدم الجاهزيه الكامله لكل الحالات

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List of abbreviation

CT	Computed Tomography
ED	Emergency Department
EH	Emergency Hospital.
ETCC	Emergency Team Coordination Course.
ICU	Intensive Care Unit.
MRI	Magnetic Resonates Imaging
WHO	World Health Organization

CHAPTER ONE
INTRODUCTION

1.1 General view

Emergency hospital: Provision of medical and surgical care to patients arriving at the hospital in need of immediate care. Emergency hospital personnel may also respond to certain situations within the hospital such cardiac arrests, fire injuries. The emergency hospital is also called the EH.

1.2 Problem and solution statement

There is no an emergency hospital stand alone; So design emergency hospital in complete way including all the section, instruments, machines and devices which is not available.

1.3 Objectives

1.3.1 General objective

- Design ideal emergency hospital.
- Improving the health care quality via availability of all the emergency devices and determine area of the hospital.
- Localize treatment in Sudan.

1.3.2 Special objectives

- Determine location and area.
- Determine section of department.
- Determine instruments.
- Qualification of medical staff, administrators, employees.

1.4 Methodology

- Collecting specific information and data about project.
- visiting hospitals and places to cover the details could help us to collect information.
- interview with engineers and people related and could help also in collecting information.
- Distribute questionnaire

- Analysis for data that we collected.
- Design the EH.

1.5 Thesis Layout

This work contains of six-chapter, **Chapter one** contains the introduction which define of the ideal emergency hospital given in then the chapter shows problem statement and the objectives of the research, in **chapter two** some terms related to the project are defined in detail were also this chapter shows the types of hospitals and level of care, **Chapter three** back ground studies. **Chapter four** illustrates the research methodology and data analysis, **Chapter five** contains the designing ideal emergency hospital using ARCHICAD & Model, **Chapter six** includes conclusion & recommendation.

CHAPTER TWO
LITERTURE REVIEW

2.1 Hospital definition

Hospital is a facility that contains medical device for diagnoses therapy or rehabilitation, and also contains beds for inpatient and medical services include continued physicians and nurses services to provide the diagnosis and therapy for patient.

A hospital is a health care institution providing patient treatment with specialized staff and equipment. [1]

2.2 Types of hospitals

There are many types of hospitals defined as follow

2.2.1 General hospital

The best-known type of hospital is the general hospital, which is set up to deal with many kinds of disease and injury, and normally has an emergency department to deal immediate and urgent threats to health. Larger cities may have several hospitals of varying size and facilities.

2.2.2 District hospital

A district hospital typically is the major health care facility in its region, with large number of beds for intensive care and long-term care.

2.2.3 Specialized hospital

Types of specialized hospital include trauma centers, rehabilitation hospitals, children's hospital, seniors' (geriatric) hospitals, and hospitals for dealing with specific medical needs such as psychiatric problems (see psychiatric hospital), certain disease categories such as cardiac, oncology, or orthopedic problems, and so forth. Specialized hospital can help reduce health care costs compared to general hospitals. [2]

2.2.4 Teaching hospital

A Teaching hospital combine's assistance people with teaching to medical studies and nurses and often is linked to a medical school, nursing school or university. In some countries like UK exists the clinical attachment system that is defined as period of time when a doctor is attached to a named supervisor in clinical unit, with the broad aims of observing clinical practice in the UK and the role of doctor and other healthcare professionals in the National Health Service.

2.2.5 Clinics

The medical facility smaller than a hospital is generally called a clinic, and often is run by a government agency for health services or a private partnership of physicians (in nations where private practice is allowed). Clinics generally provide only outpatient services.

2.3 Level of Care

According to the models that supported by health organization (WHO) the level of care may classify as follow:

- Family and home.
- Community health activity.
- First health facility (sub-district).
- First referred level (district).
- .second referred level (Provincial).
- Third referred level (National).
- .High referred level.

2.4 Planning

The planning is done by determine location, area, bring medical device, choosing and testing medical device.

2.5 Management of hospital

A functional sequence illustrates the responsibilities of each section.

As it is shown in the following

- General Director
- Medical Director
- Staff specialists
- Nurses
- Medical Engineer
- Maintenance technician
- Administration
- Accountants
- Network Engineer
- Security

2.6 Standardization

- Relative calm
- Far from the areas of wind and dust and smoke and odours
- Leave enough area of land Sweepers service and gardens planted with evergreen trees to reduce noise
- Make sure the design of an integrated hospital and functionally
- The ability to accommodate the new requirements

CHAPTER THREE
BACKGROUND STUDIES

Ru Ding (2006)The purpose of this study was to identify patient characteristics associated with uncompleted visits, controlling for emergency department and hospital environments, as well as the clinical urgency of the patients. To do this, patients who left without being seen (cases) were matched to patients who stayed and were treated (controls) by their registration data and time and triage level. The study was designed to answer the following question: among patients who present to the emergency department on the same day, at the same time, with the same acuity, what differentiates patients who stay and are treated from those who leave without being seen. [3]

Jon Huddy (2014) The Emergency Department plays a pivotal role in providing the public with access to acute health care, and the provision of support to primary health care and community services. An Emergency Department is also an important interface to the many inpatient and outpatient services offered by its parent hospital and the health service of which it is a part. In addition, a large proportion of the total acute admissions to inpatient wards are via Emergency Departments, both in Australia and New Zealand. Due to the increasing patient load on Emergency Departments throughout Australasia and internationally, extensive work has been carried out to develop improved models of (patient) care that aid patient flow through the Emergency Department. Many different solutions have been used successfully to aid patient flow. It should always be considered that barriers to patient flow and especially access block are symptoms of hospital-wide problems. It is therefore strongly recommended that any work on clinical service redesign and redevelopment extends beyond the Emergency Department to incorporate the entire hospital. The goal for any model of care should be to reduce unnecessary steps in the patient journey, and to optimise the timeliness of all the essential components of the journey. Each individual Emergency Department presents its own challenges, and no one

solution fits all. For patient privacy, ideally all Emergency Department cubicles are single, For cubicles, three walls and curtain (as a minimum) are required ,Certain types of cubicles should include walls/robust partitions and a door for privacy and noise attenuation; especially those for paediatric patients, migraine patients, and for gynaecological procedures.[4]

Mr Fergal Hickey (2007) Medicine is a near-unique specialty based upon the requirement for Time-critical care delivered on a 24 hour, 7 day basis. The unique characteristics Of this practice which influence departmental design are outlined in: High levels of activity, High patient turnover, Varied case mix , Large multi-disciplinary workforce, Need for efficiency of process , Infection control requirements, Access issues, Interface with pre-hospital services, Multiple interactions with in-hospital specialties / patient transfers, Communications issues , Potential for growth, Teaching activities, Major Incident capacity, Responsiveness to local service demands / social issues, Administrative functions – EM specific, Possibility of aggression/assault – security issue.

There should be separate entrances to the ED for walking and ambulance Patients. The ED entrances must never be used as general entrances to the Hospital or as thoroughfares for staff and non-ED patients moving within the Hospital, as this has a detrimental effect on ED patient care and privacy and Potentially compromises patient and staff safety. Security personnel must be Deployed on a 24/7 basis to ensure that all access routes remain clear. The ED Clinical areas should not be accessible to medical, nursing or other staff that are Not in the ED on specific patient care business. The access needs of young children are similar to those of disabled people. Free car parking spaces, reserved for disabled people and for carers with babies And young children, should be allocated beside the ED.[5]

Dr. M J Shapiro (2004) Objective to determine if high fidelity simulation based team training can improve clinical team performance when added to an existing didactic teamwork curriculum. Setting: Level 1 trauma centre and academic emergency medicine training program. Participants' Emergency department (ED) staff including nurses, technicians, emergency medicine residents, and attending physicians. Intervention: ED staff who had recently received didactic training in the Emergency Team Coordination Course (ETCC) also received an 8 hour intensive experience in an ED simulator in which three scenarios of graduated difficulty were encountered. A comparison group, also ETCC trained, was assigned to work together in the ED for one 8 hour shift. Experimental and comparison teams were observed in the ED before and after the intervention. Design single, crossover, prospective, blinded and controlled observational study. Teamwork ratings using previously validated behaviourally anchored rating scales (BARS) were completed by outside trained observers in the ED. Observers were blinded to the identification of the teams. Results there were no significant differences between experimental and comparison groups at baseline. The experimental team showed a trend towards improvement in the quality of team behaviour ($p=0.07$); the comparison group showed no change in team behaviour during the two observation periods ($p=0.55$). Members of the experimental team rated simulation based training as a useful educational method. Conclusion high fidelity medical simulation appears to be a promising method for enhancing didactic teamwork training. This approach, using a number of patients, is more representative of clinical care and is therefore the proper paradigm in which to perform teamwork training. It is, however, unclear how much simulator based training must augment didactic teamwork training for clinically meaningful difference to become apparent. [6]

CHAPTER FOUR
METHODOLOGY AND DATA ANALYSIS

4.1 Methodology

Collecting information from books, magazine, webs, papers, researches related to the emergency hospital and how to design the hospital following the right standards that related to emergency, most of the information was collecting from web sides, the links will be shown in the references. First of all, we define the emergency hospital, benefits, specific details about the department and designing of the department and which program will execute the design for example (**ARCHICAD**) and this is the program that we will use to solve the problem. Visiting hospital and clinics and every place related to the department to collect specific details about the department, we have visit 6 hospitals, ministry health and diagnostic center, to see the department of the radiology to get more information, and make it integrated in all aspects of design and services to serve the patient better. Making interviews with engineers to ask about the department is very important in designing emergency hospital because engineers has much and important information's about emergency hospital, also asking engineering will help much in designing the department and could collect important information.

Survey field of these the survey the emergency room staff either doctors, nurses and medical administration. The criteria of this study included the emergency room area, medical device evaluation, staff and train radiology department, laboratory, maximizes operation room and ICU, room observation and patient services. The field was used to identify problems and issues of ED. Study duration a period of five month (from May 2017 to Sep 2017)

4.2 Data analysis

The interview guided by questionnaires such as:

Emergency hospital area enough for help and serve all patient in emergency cases

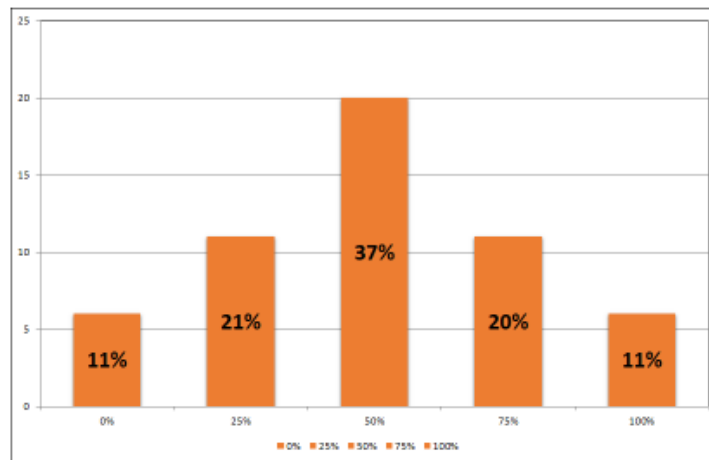


Figure (4.1) area of ED

Reduced medical services for patient during emergency department is crowding

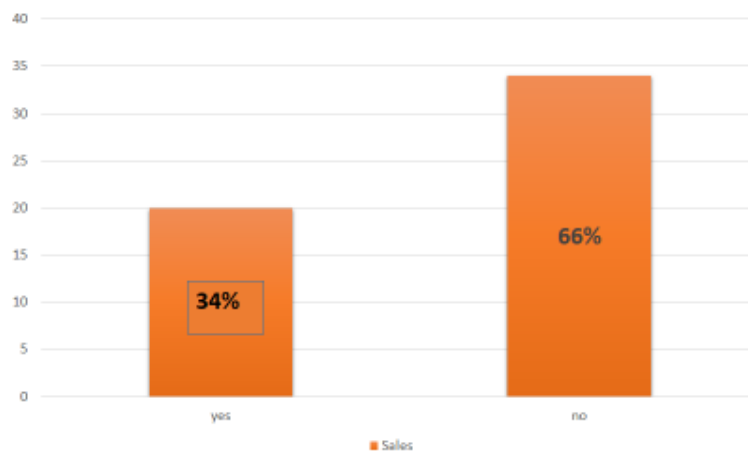


Figure (4.2) medical services

Hospital site helps the arrival of patients in less time

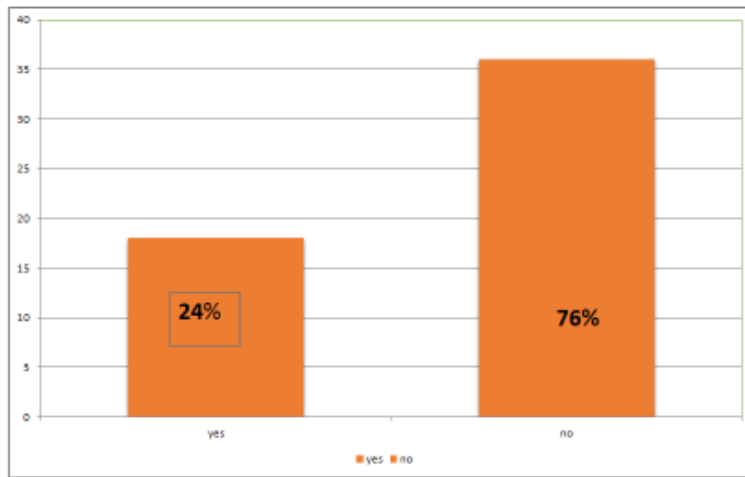


Figure (4.3) arrival of patients

Ambulances fitted to the emergency department

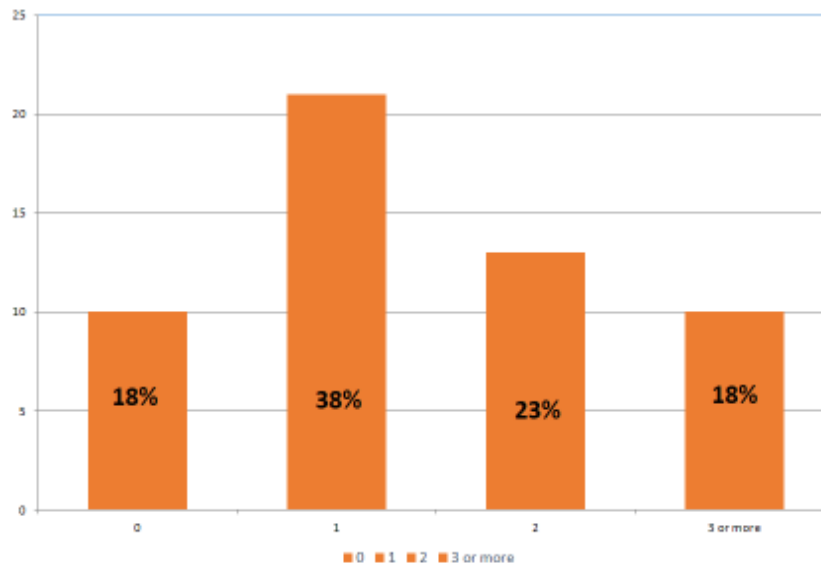


Figure (4.4) ambulances fitted

Cases that transfer to other hospital

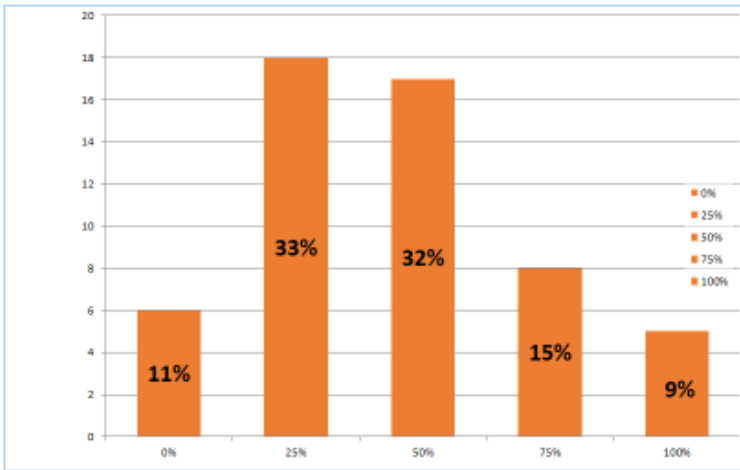


Figure (4.5) transfer cases

Maintenance efficiency

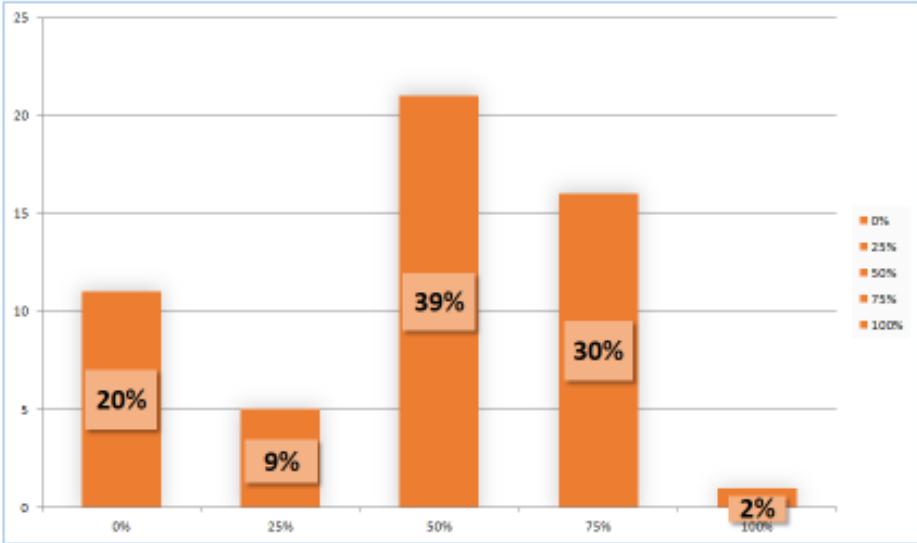


Figure (4.6) maintenance efficiency

Difficulty in providing medical disposables for emergency cases

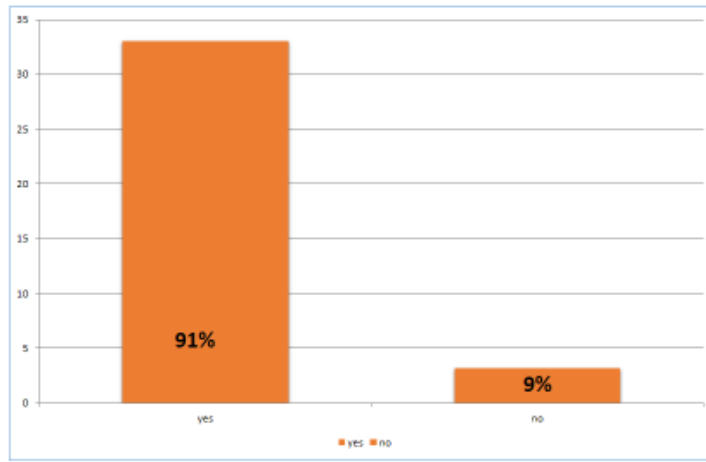


Figure (4.7) medical disposables

The emergency department contain all medical equipment needed for emergency situation

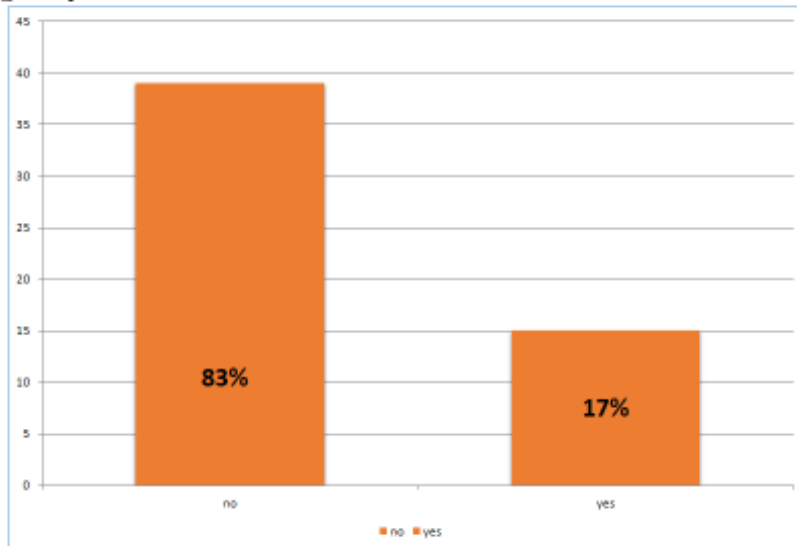


Figure (4.8) sufficient equipment

sufficient number of trained emergency physicians and nurses

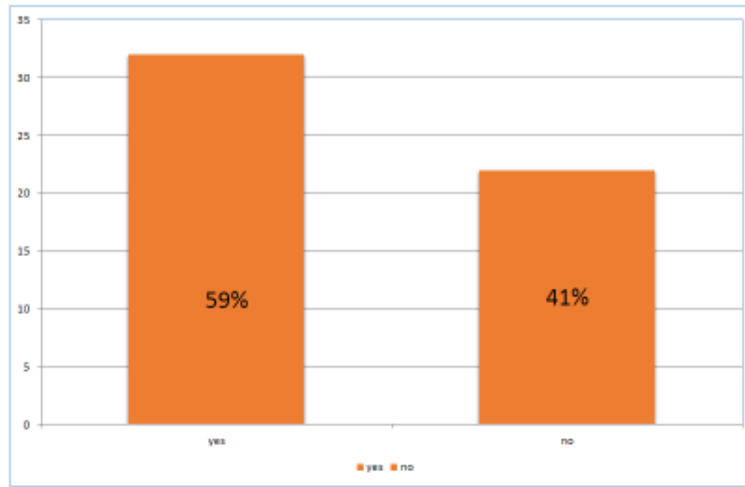


Figure (4.9) sufficient trained

the emergency department needs to reworked whether in design or regulation

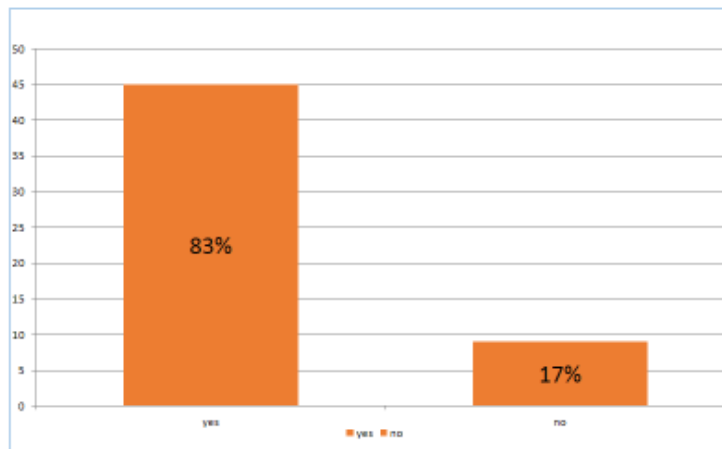


Figure (4.10) rework of ED

the emergency department can be more helpful separate as independent hospital

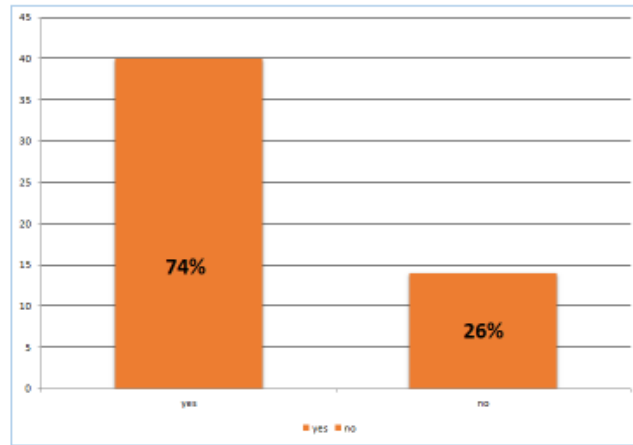


Figure (4.11) separate of ED

The needed of police station in the emergency department

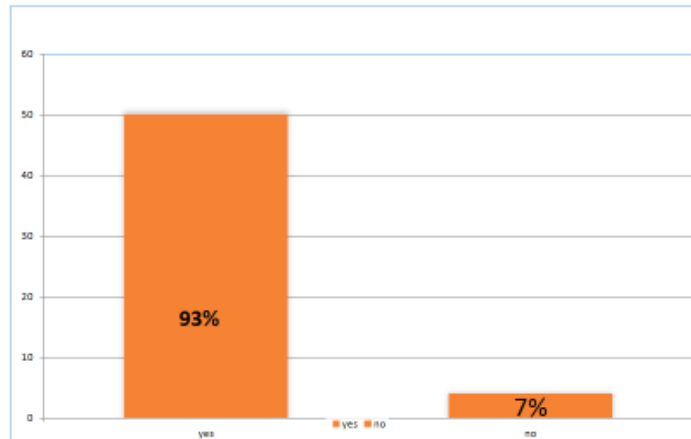


Figure (4.12) police office

Through analysis and study found that they are several problems in public hospitals can be summarized as follows:

- There are number of patients transferred from public hospitals to other hospitals without treatment or first aid.
- Most hospitals didn't have sufficient of equipped ambulance.
- In sufficiency of medical device on ED on some hospitals.
- Unavailability of trained staff in public hospitals to provide the best emergency services and medical care.

CHAPTER FIVE
DESIGN

5.1 designing Ideal emergency hospital departments must take into account

- Room Dimensions & Device dimensions.
- Defining the size of the emergency hospital
- Defining size of the rooms
- Define the number of rooms
- Protect the patient in the hospital when he enters until exit the Hospital
- Number of patients per year.
- Number of hospital beds.
- Outpatient-to-inpatient ratio
- Machine workload.
- Total space necessary = Number of examinations per year

4.5

5.2 Building

As show in figure (5.1) &(5.2) below

5.2.1 Observation room

Have two room:

First area that patient take care

Total space (10.76m*23.06m) include:-

Doctor office (3.60m*3.31m)

Nurse office (3.60m*3.36m)

CO-Patient waiting area (1.8m*7.91m)

Staff rest (7.2m*4.88m)

Police office (2.05m*2.23m)

Ten bed for each room

As show in figure (5.3) below

5.2.2Pharmacy

The area of pharmacy (8.43m*10.76m)

5.2.3 Radiology department

Total space (19.3m*13.76m)

5.2.4 X-ray room

The size of the X-RAY in design is (4.20m x 7.20m).

X-ray located on ground floor

The number of doors should be kept minimum.

The unit should be placed so that it's not possible to direct radiation towards areas of high occupancy.

X-ray Warning light and sign

Dark room should be located near the x-ray room.

As show in figure (5.4) below

5.2.5 Dental X-ray

The size of the dental X-RAY in design is (5.66m x 5.40m). include In design consist of two dental x-ray devices.

Medical office

Waiting room.

5.2.6 MRI

The size of the MRI in our design is (7.16m x 12.10m).

A control room shall be provided with full view of the MRI Power conditioning shall be provided.

Magnetic shielding shall be provided.

Adequate space for Coils storage based on the on these anatomic applications.

Magnetic door interlock.

MRI Warning light and signs.

Compatible MRI medical equipment's including but not limited to sphygmomanometer, wheel chair and injector.

As show in figure (5.5) below

5.2.7Ultrasound

The size of the ultrasound in our design is (4.20m x 4.00m).

Patient toilet shall be accessible within the ultrasound room with nursing call system.

Lighting fluorescent lights will provide illumination level up to 40 FC during patient transfer on and from the table.

As show in figure (5.6) below

5.2.8Computed Tomography (CT)

The size of the CT in our design is (4.20m *7.00m).

The number of doors should be kept minimum.

A view window shall be provided to permit full view of the patient A patient toilet shall be provided. Door switch with NO/NC contacts Connect to CT system control circuit

- Warning light with wording "CT IN USE, DO NOT ENTER"
- As show in figure (5.7) below

5.2.9 Intensive care unit (ICU)

Total space (19.83m*7.82m)

As show in figure (5.8) & (5.9) below

5.2.10 Operation room

Consist of the following

Preparation (4.20m*2.40m)

Stylization of patient (4.20m*1.90m)

Stylization of equipment consist

Storage (1.10m*3.00m)

Sterilization (1.10m*3.00m)

Washing (1.10m*3.00m)

Chang staff (3.50m*2.00m)

Reporting (3.00m*2.20m)

Operation theatre one (6.80m*7.80m)

Operation theatre two (6.80m*7.80m)

As show in figure (5.10) & (5.11) below

5.2.11 Laboratory

Total space (10.8m*8.43m) Consist:

Two examination room (2.92m*3.60m)

Path room (3.00M*3.60m)

Receptions (4.m*5.00m)

Account (3.10m*4.20m)

Laboratory specialist office (4.00m*3.20m)

Store (3.00m*2.30m)

Washing room (5.50m*2.00m)

5.2.12 Morgue

Total space (5.50m*4.50m)

5.2.13 Blood bank

Total space (4.20m*3.30m)

5.2.14 Administration area

Total area (20m*13.8m)

5.2.15 Wards

Consist of two wards the area of one (10.8m*33.5m)

As show in figure (5.12) & (5.13) below

5.2.16 Nurse Station

Total area (6.8m*7.7m)

5.3 equipment

- Patient bed.
- mobile x-ray
- monitor
- mobile drip stand
- disposable curtain screens.
- toilet surrounds.
- wheel chair.
- clinical waste bags
- operating lamp
- operating table
- patient monitor
- anesthesia
- C-arm x-ray
- Surgical instrument trolley.

- ventilator
- Dc-shock
- suction
- infusion pump
- ultra sound
- nebulizer
- autoclave
- spectrophotometer
- centrifuge
- oven
- microscope
- hematology
- water pass
- chemistry analysis
- flame photometer

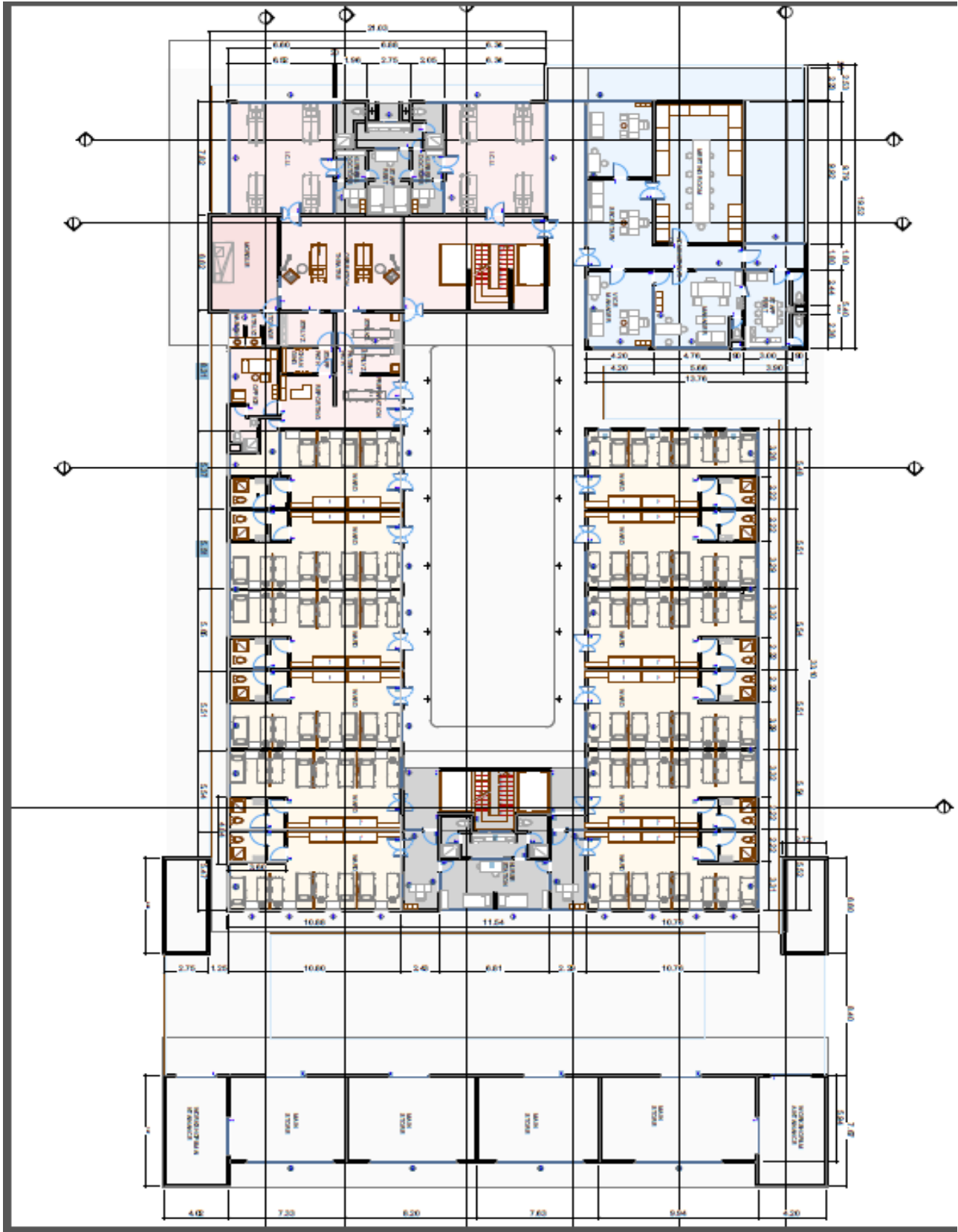


Figure (5.1) 2D first floor



Figure (5.3) Observation room

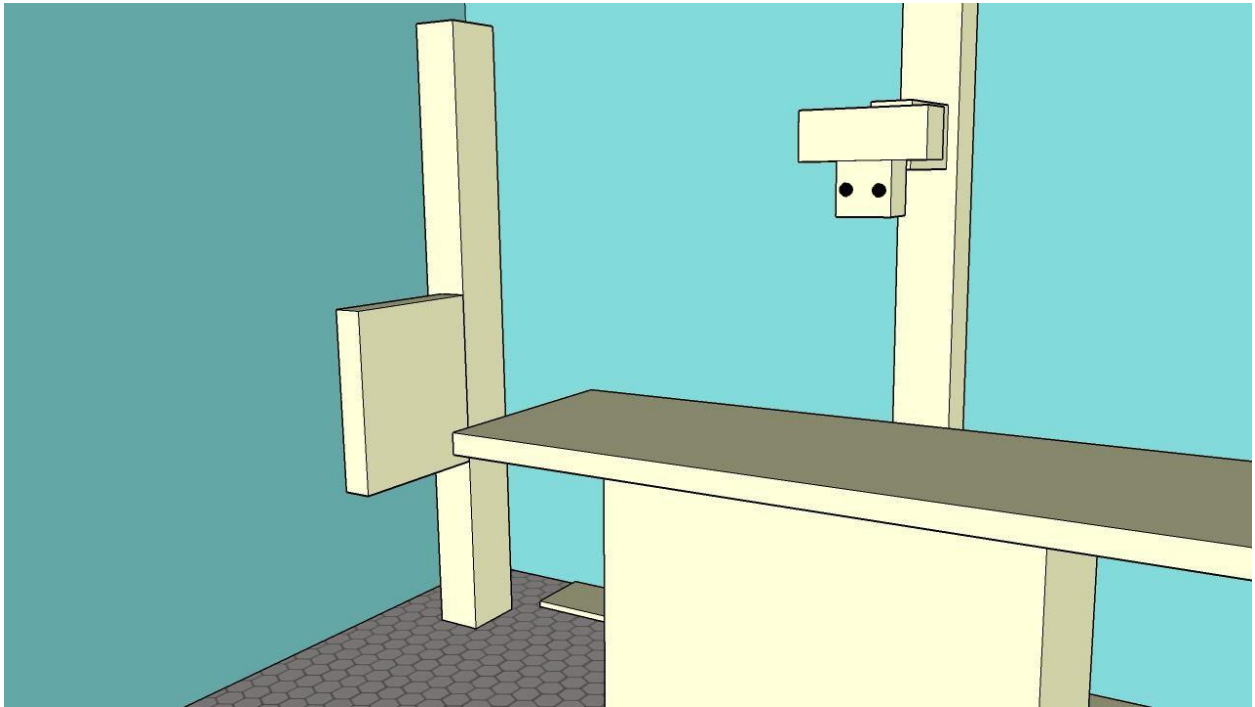


Figure (5.4) X-RAY

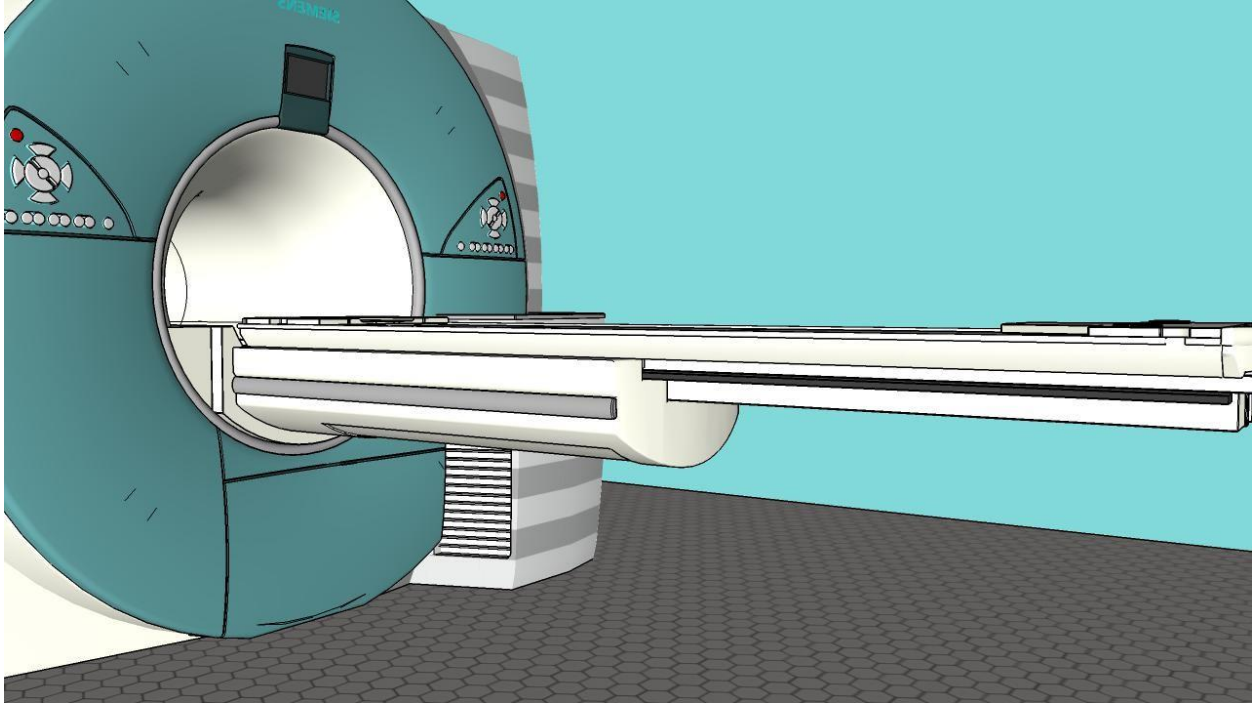


Figure (5.5) MRI

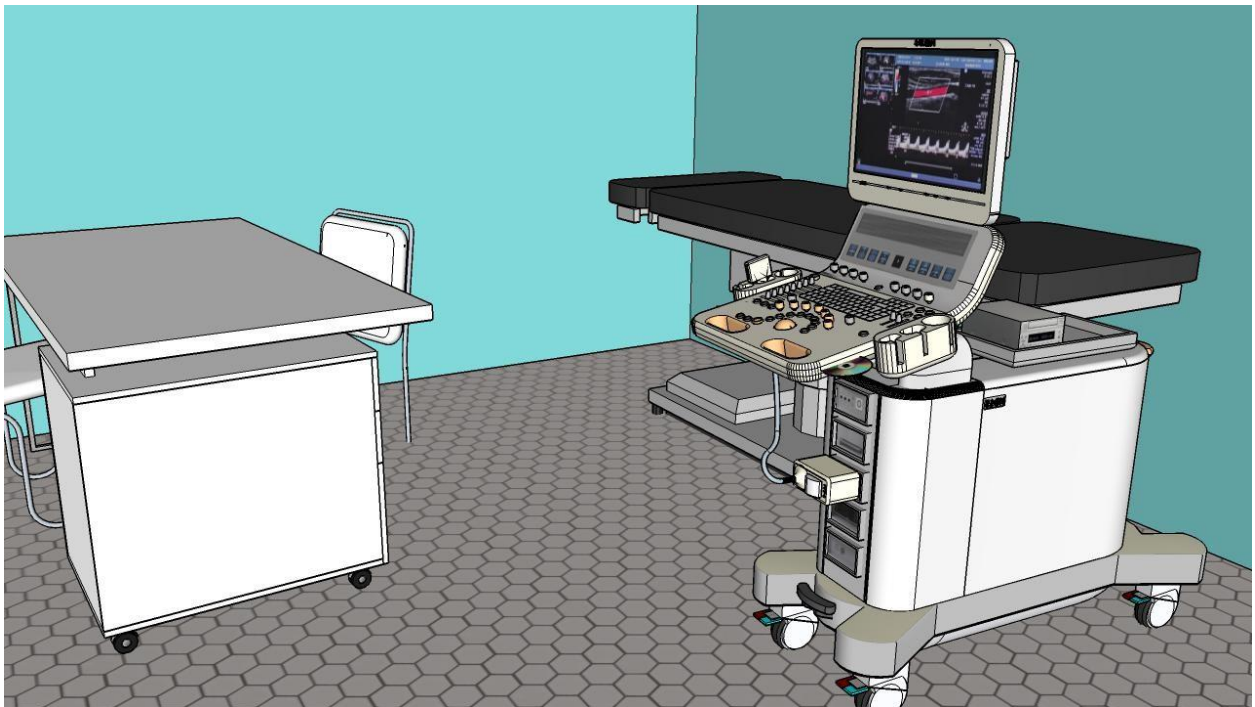


Figure (5.6) ultra sound



Figure (5.7) CT

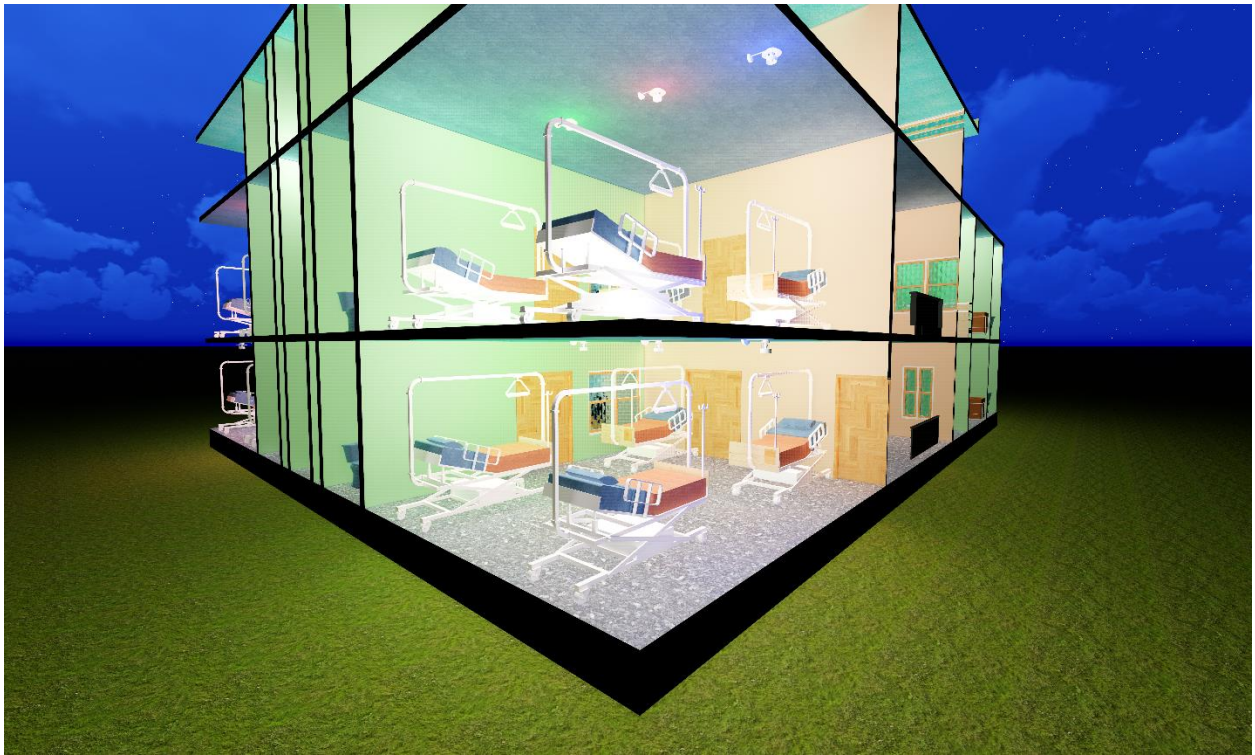
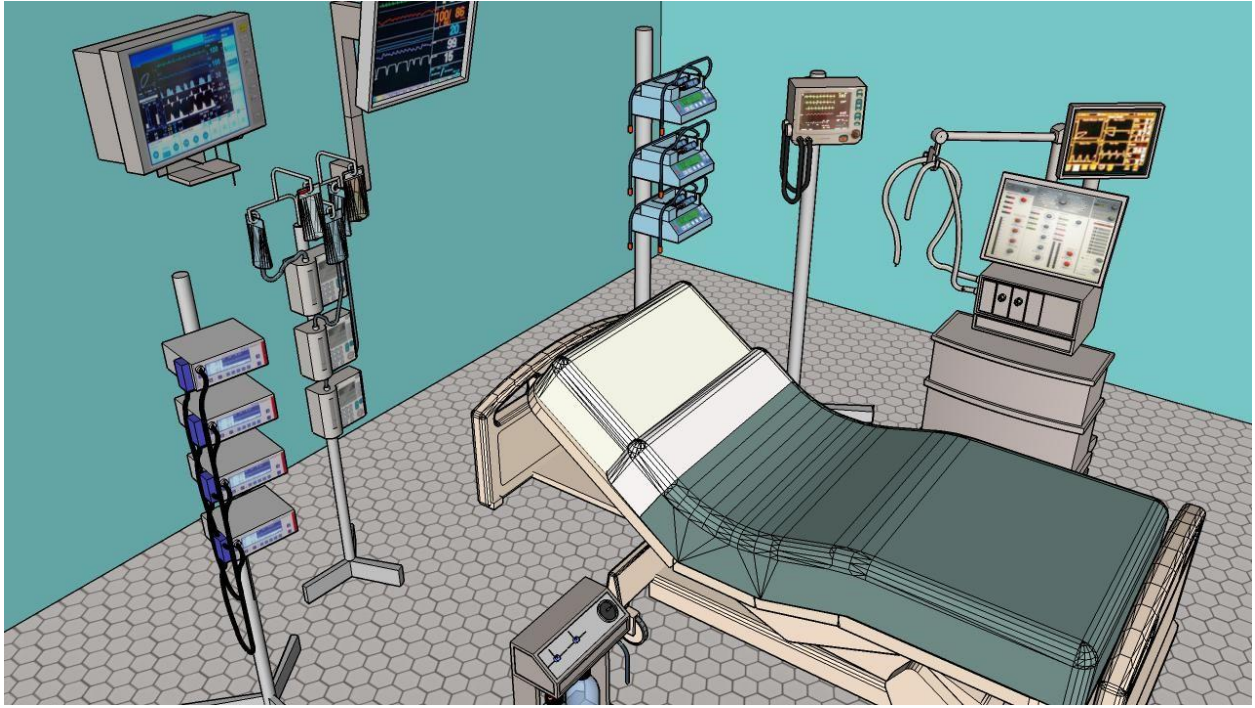


Figure (5.8) ICU



FIGUER (5.9) ICU

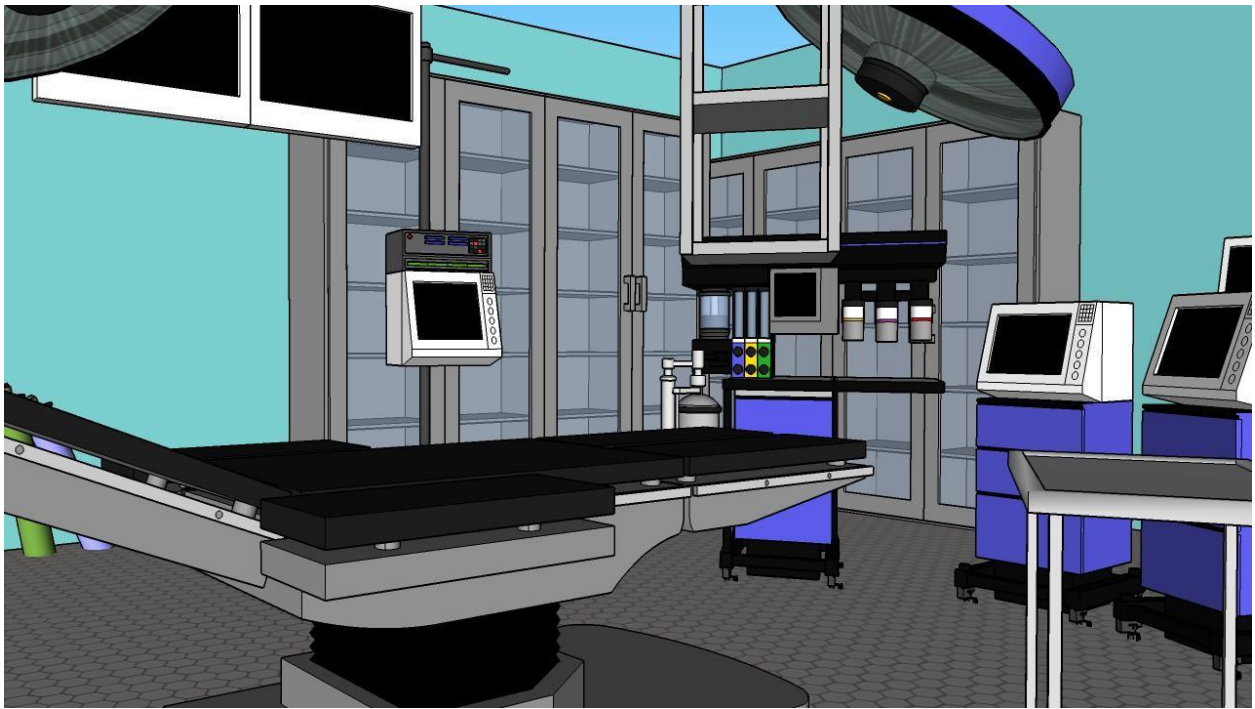


Figure (5.10) operation room



Figure (5.11) operation room

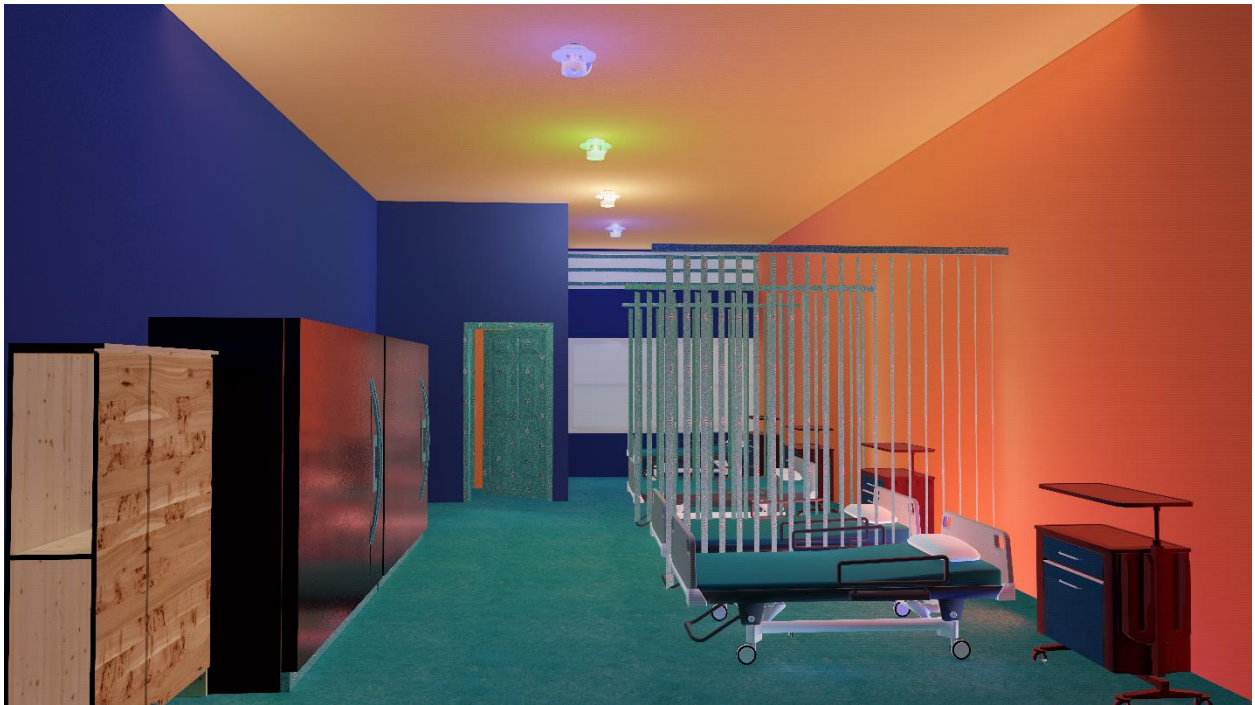


Figure (5.12) wards

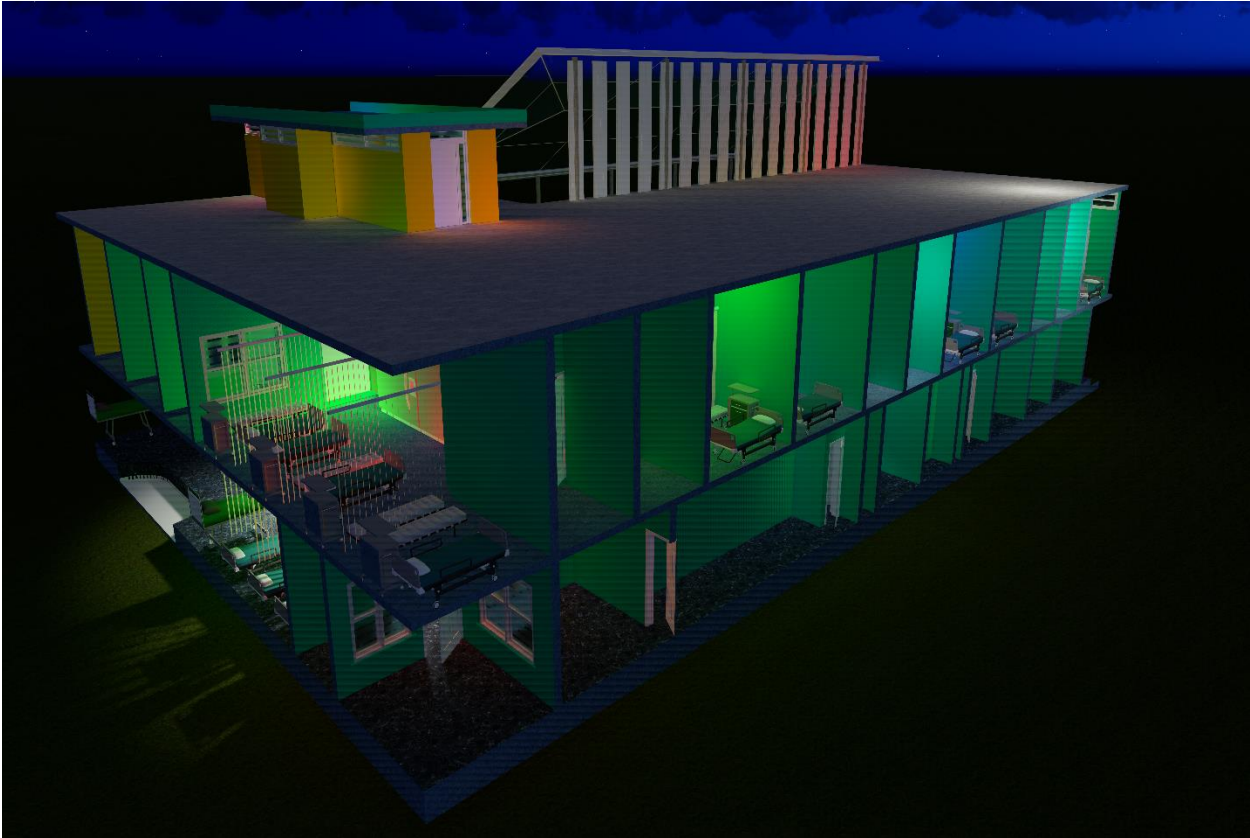


Figure (5.13) wards

CHAPTER SIX
CONCLUSION & RECOMMENDATION

6.1 conclusions

At the end of this research this project is helping and improving the medical services and equipment filled in our country as general, and for the ideal emergency hospital as specification and it takes effort to do that. Tried to design the hospital in complete way containing all instrument, machine and device with suitable space to make comfortable move for patient and doctor inside the hospital from entrance until exit from emergency hospital.

6.2 recommendation

- The emergency hospital deigning team must be containing of trained and professional biomedical engineering.
- The hospital location should be selected carefully and never be inside cantons.
- Ambulance should be fully equipped by emergency equipment to be very suite for emergency cases and become the initial care unit.
- Importance of availability of trained an emergency medical staff to receive the patient who arrives to hospital in a special way or ambulance from outside the facility and start the diagnose until arrives to the examination room

