

Chapter one

Introduction

Chapter one: Introduction

1.1 General View

A hospital as a health care organisation has been defined in varied terms as an institution involved in preventive, curative/ameliorative, palliative or rehabilitative services. However, the definition given by the World Health Organisation (WHO) is quite exhaustive and exclusive, in which a hospital is defined as ‘an integral part of the medical and social organisation which is to provide for the population complete health care, both curative and preventive; and whose out-patient services reach out into the family in its home environment. The hospital is also a centre for the training of health workers and for bio-social research.[1]

An emergency department (ED), also known as an accident & emergency department (A&E), emergency room (ER) or casualty department, is a medical treatment facility specializing in emergency medicine, the acute care of patients who present without prior appointment; either by their own means or by that of an ambulance. The emergency department is usually found in a hospital or other primary care center.[]

Due to the unplanned nature of patient attendance, the department must provide initial treatment for a broad spectrum of illnesses and injuries, some of which may be life-threatening and require immediate attention. In some countries, emergency departments have become important entry points for those without other means of access to medical care.[2]

Emergency medicine, formerly known in some countries as accident and emergency medicine, is the medical specialty involving care for undifferentiated and unscheduled patients with illnesses or injuries requiring immediate medical attention. In their role as first-line providers, emergency physicians are responsible for initiating investigations and interventions to diagnose and/or treat patients in the acute phase (including initial resuscitation and stabilization), coordinating care with physicians from other specialists, and making decisions regarding a patient's need for hospital admission, observation, or discharge. Emergency physicians generally practice in hospital emergency departments, pre-hospital settings via emergency medical

services, and intensive care units, but may also work in primary care settings such as urgent care clinics.[3]

1.2 Problems statement

Since The big role of emergency department these limitations such as_ Emergency room over crowding,Long waiting for investigation and results,Slowdown in care when a trauma arrives,Shortage of specialists, Lack of disaster preparedness, Shortcoming in pediatric emergency care _affect the emergency medicine and affect the health care delivered to patients.

1.3 Objectives

There are two main objectives of this project general objective and specific objectives.

1.3.1 General Objectives:

The general objective of this project is design of separate building for only emergency and trauma cases to get rid of the emergency department's problems and to improve the emergency services.

1.3.2 Specific Objectives:

- Widen the area lead to Eliminate the crowding in current state .
- Availability of specialist staff will Increase Efficiency of the Emergency management to reach the optimum services to the patients.
- Applying the design standards to build a hospital make the management of cases more easier for specialized doctor of the department.
- Availability of emergency specialists 24 hour in the hospital will reduce the trauma disasters and death.

1.4 Methodology:

Design an emergency hospital will improve the future of emergency medicine, the methodology depend on the current situation in country. Data collected through the visits to the health care facilities and ministries,

Survey about the emergency services proceed in different areas,interviews and questionnaire . Then data analysed to determine suitable location for the hospital ,calculate the suitable area and space depend on the estimated population in that area and determine the required equipment and instruments for all departments to make the appropriate design .

1.5 thesis layout:

This project consists of six chapters ; chapter one (Introduction) contains general view ,problem statement,objectives (general and specific) and research methodology.Chapter Two about theoretical fundamentals consists of hospital definition ,standard of hospital design ,emergency medicine,emergency department ,emergency department design and equipment planning.chapter three reveals the background studies .chapter four illustrates the methodology of this research and data analysis.chapter five contains the design steps,hospital location ,area,plan design ,ARCHICAD design,3D design ,interior design ,equipment planning ,hospital system ,staff planning and cost estimation .chapter seven which contain discussion ,conclusion ,recommendations.

Chapter Two

Theoretical Fundamentals

Chapter 2: Theoretical Fundamentals

2.1 Hospital

The hospital is an integral part of a social and medical organization, the function of which is to provide for the population complete health care, both curative and preventive, and whose out-patient services reach out to the family and its home environment. [1]

The first task of the health service is to reach all the people all the time at the best level of care the country can afford. [1]

The care environment is constituted by those features in a built health care entity that are created, structured, and maintained to support quality health care. As patients and their families have become more involved in the course of care, facilities need to respond to the changing requirements for accommodations. The health care environment should enhance the dignity of the patient through features that permit privacy and confidentiality. [4]

Stress can be a major detriment to the course of a patient's care. The facility should be designed to reduce patient, family, and staff stress wherever possible. [4]

2.1.1 Hospital design standards

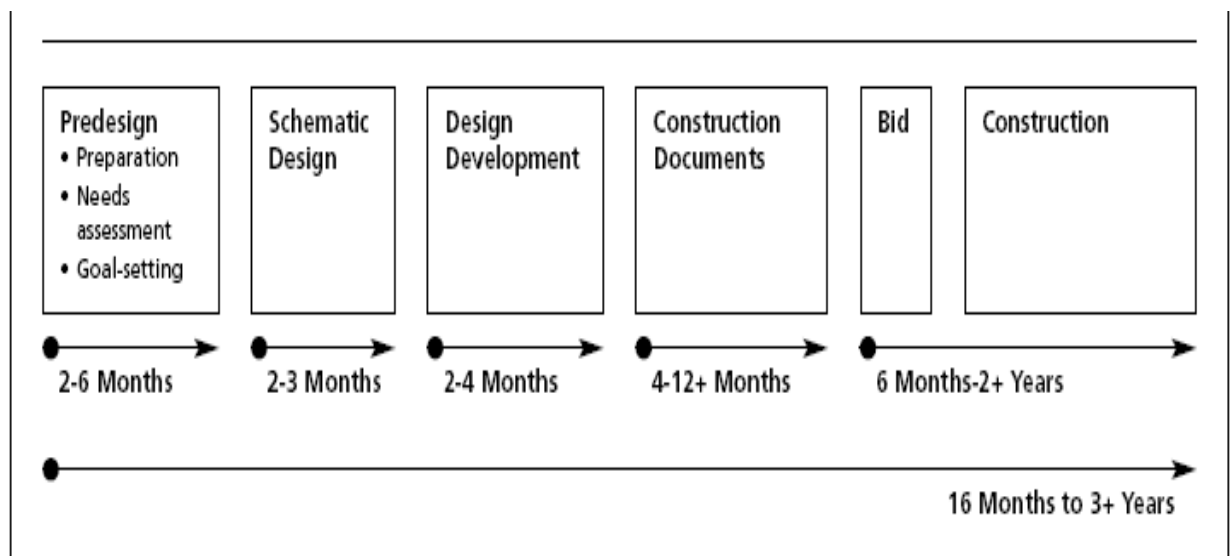


Figure 2.1 :hospital design steps

Hospital Building Phases consist of Feasibility Study (need Assessment), Medical Planning , Architect and structure Design ,Electromechanical design , Medical Equipment , Construction, Commision.

Planning for health care facilities shall include,in addition to space and operational needs,provisions for infection control and protection of patients during any renovations or new construction.

During the programming phase of a construction project,the owner shall provide an Infection Control Risk Assessment (ICRA).An ICRA is a determination of the potential risk of transmission of various agents in the facility.This continuous process is an essential component of a facility functional or master program to provide a safe environment of care.The ICRA shall be conducted by a panel with expertise in infection control,risk management,facility design, construction,ventilation,safety,and epidemiology. The panel shall provide updated documentation of the risk assessment throughout planning,design,and construction.The ICRA shall only address building areas anticipated to be affected by construction.

The ICRA is initiated in design and planning and continues through construction and renovation.After considering the facility's patient population and programs,the ICRA shall address but not be limited to the following key elements:

- (a) The impact of disrupting essential services to patients and employees
- (b) Patient placement or relocation
- (c) Placement of effective barriers to protect susceptible patients from airborne contaminants such as *Aspergillus* sp.
- (d) Air handling and ventilation needs in surgical services,airborne infection isolation and protective environment rooms,laboratories,local exhaust systems for hazardous agents,and other special areas
- (e) Determination of additional numbers of airborne infection isolation or protective environment room requirements

Consideration of the domestic water system to limit *Legionella* sp.and waterborne opportunistic pathogens

The assessment for internal and/or external construction projects also includes patient protection from demolition,ventilation and water management following planned or unplanned power outages,movement of debris,traffic flow,cleanup,and certification.

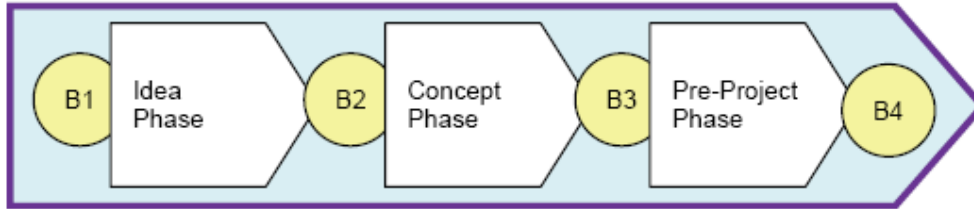


Figure 2.2: design phases.

2.1.2 Standards of Hospital Design:

As technology changes, flexibility is in the best interests of quality care. As health care economics apply pressure to management, design should make every effort to enhance the performance, productivity, and satisfaction of the staff in order to promote a safe environment of care. Creativity should be encouraged in the design process to enhance the environment of care.

2.1.2.1 Location

Access The site of any health care facility shall be convenient both to the community and to service vehicles, including fire protection apparatus,etc.Availability of Transportation.

Health facilities shall have security measures for patients,families,personnel,and the public consistent with the conditions and risks inherent in the location of the facility.

Availability of Utilities Facilities shall be located to provide reliable utilities (water,gas,sewer,electricity).The water supply shall have the capacity to provide normal usage plus firefighting requirements.The electricity shall be of stable voltage and frequency.[5]

2.1.2.2 Facility Site Design

Paved roads shall be provided within the property for access to all entrances and to loading and unloading docks (for delivery trucks). Hospitals with an organized emergency service shall have the emergency access well marked to facilitate entry from the public roads or streets serving the site. Other vehicular or pedestrian traffic should not conflict with access to the emergency station. In addition, access to emergency services shall be located to incur minimal damage from floods and other natural disasters. Paved walkways shall be provided for pedestrian traffic.

Parking shall be made available for patients, families, personnel, and the public, as described in the individual sections for specific facility types. Signage shall be provided to direct people unfamiliar with the facility to appropriate parking areas. [5]

2.1.2.3 Critical Care Units:

Critical care units require special space and equipment considerations for safe and effective patient care, staff functions, and family participation. Families and visitors to critical care units often wait for long periods of time, including overnight stays, under highly stressful situations. They tend to congregate at unit entries to be readily accessible to staff interaction. Design shall address such issues as privacy, atmosphere, and aesthetics for all involved in the care and comfort of patients in critical care units. In addition, space arrangement shall include provisions for immediate access of emergency equipment from other departments.

Not every hospital will provide all types of critical care. Some hospitals may have a small combined unit; others may have separate, sophisticated units for highly specialized treatments. Critical care units shall comply in size, number, and type with these standards and with the functional program. The following standards are intended for the more common types of critical care services and shall be appropriate to needs defined in functional programs. Where specialized services are required, additions and/or modifications shall be made as necessary for efficient, safe, and effective patient care. [5]

Critical Care (General) The following shall apply to all types of critical care units unless otherwise noted. Each unit shall comply with the following provisions:

The location shall offer convenient access from the emergency, respiratory therapy, laboratory, radiology, surgery, and other essential departments and services as defined by the functional program. It shall be located so that the medical emergency resuscitation teams may be able to respond promptly to emergency calls within minimum travel time. The location shall be arranged to eliminate the need for through traffic.[5]

In new construction, each patient space (whether separate rooms, cubicles, or multiple bed space) shall have a minimum of 200 square feet.

2.1.2.4 Surgical Suites

The number of operating rooms and recovery beds and the sizes of the service areas shall be based on the expected surgical workload. In the program, the size, location, and configuration of the surgical suite and support service departments shall reflect the projected volume of outpatients. This may be achieved by designing either an outpatient surgery facility or a combined inpatient-outpatient surgical suite. The surgical suite shall be located and arranged to prevent nonrelated traffic through the suite.

The clinical practice setting shall be designed to facilitate movement of patients and personnel into, through, and out of defined areas within the surgical suite. Signs shall clearly indicate the surgical attire required.

The surgical suite shall be divided into three designated areas—unrestricted, semi-restricted, and restricted—that are defined by the physical activities performed in each area.

The unrestricted area includes a central control point established to monitor the entrance of patients, personnel, and materials. Street clothes are permitted in this area, and traffic is not limited.[5]

The semi-restricted area includes the peripheral support areas of the surgical suite and has storage areas for clean and sterile supplies, work areas for storage and processing of instruments, and corridors leading to the restricted areas of the surgical suite. Traffic in this area is limited to authorized personnel and patients. Personnel are required to wear surgical attire and cover all head and facial hair.

The restricted area includes operating and procedure rooms, the clean core, and scrub sink areas. Surgical attire and hair coverings are required. Masks are required where open sterile supplies or scrubbed persons may be located. [5]

2.1.2.5 General operating room(s)

In new construction, each room shall have a minimum clear area of 400 square feet (37.16 square meters) exclusive of fixed or wall-mounted cabinets and built-in shelves, with a minimum of 20 feet (6.10 meters) clear dimension between fixed cabinets and built-in shelves; and a system for emergency communication with the surgical suite control station. X-ray film illuminators for handling at least four films simultaneously shall also be provided. [5]

A room for orthopedic surgery. When included, this room shall, in addition to the above, have enclosed storage space for splints and traction equipment. Storage may be outside the operating room but must be conveniently located. If a sink is used for the disposal of plaster of Paris, a plaster trap shall be provided.

Room(s) for surgical cystoscopic and other endo-urologic procedures. This room shall have a minimum clear area of 350 square feet (32.52 square meters) exclusive of fixed or wall-mounted cabinets and built-in shelves with a minimum of 15 feet (4.57 meters) clear dimension between fixed cabinets and built-in shelves. X-ray viewing capability to accommodate at least four films simultaneously will be provided. In renovation projects, rooms for surgical cystoscopy may have a minimum clear area of 250 square feet (23.28 square meters). [5]

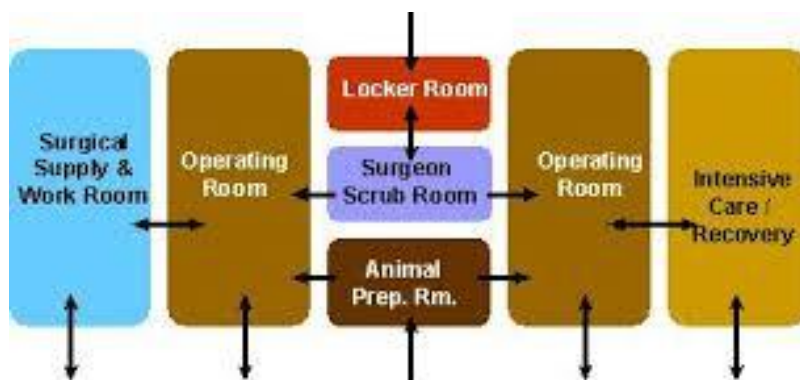


Figure 2.3 :surgery suite functional relationship diagram

2.1.2.6 Obstetrical Facilities

The obstetrical unit shall be located and designed to prohibit non-related traffic through the unit. When delivery and operating rooms are in the same suite, access and service arrangements shall be such that neither staff nor patients need to travel through one area to reach the other. Except as permitted otherwise herein, existing facilities being renovated shall, as far as practicable, provide all the required support services. [5]

2.2 Emergency medicine

Emergency medicine represents the unique combination of rapid data gathering, simultaneous prioritization, and constant multi-tasking in a time-constrained fish bowl – with all decisions subject to second-guessing by others. It is a patient complaint-oriented speciality in which stabilization based on anticipation supersedes lengthy differentials and diagnostic precision. In light of these unique aspects and attributes of clinical practice, one would expect the textbook-based literature supporting this speciality to be uniquely written and reflective of its singular approach. This has rarely been the case, a fact that has puzzled me for almost 30 years. It is true that sequential prose does not accurately represent the parallel processing necessary to practice effective and efficient emergency medicine. Still, it would seem the ideas of priority diagnoses, stabilization, initial assessment, prioritized differential diagnosis, and the rest that follows could be delineated and emphasized within the limitations of the printed word.[6]

2.3 Emergency Department

The emergency department is a core clinical unit of a hospital and the experience of patients attending the emergency department significantly influences patient satisfaction and the public image of the hospital.[1]

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.[2]

Its function is to receive, triage, stabilise and provide emergency management to patients who present with a wide variety of critical, urgent and semi urgent conditions whether self or otherwise referred. The emergency department also provides for the reception and management of disaster patients as part of its role within the disaster plan of each region. In addition to standard treatment areas, some departments may require additional specifically designed areas to fulfil special roles, such as:

- The management of paediatric patients
- The management of major trauma patients
- The management of psychiatric patients
- The management of patients following sexual assault
- The management of infectious patients
 - The extended observation and management of patients
- The management of prisoners in custody
- The management of patients affected by chemical, biological or radiological incidents
- Undergraduate, postgraduate teaching
 - Transport and retrieval services
- Telemedicine In addition to clinical areas. [7]

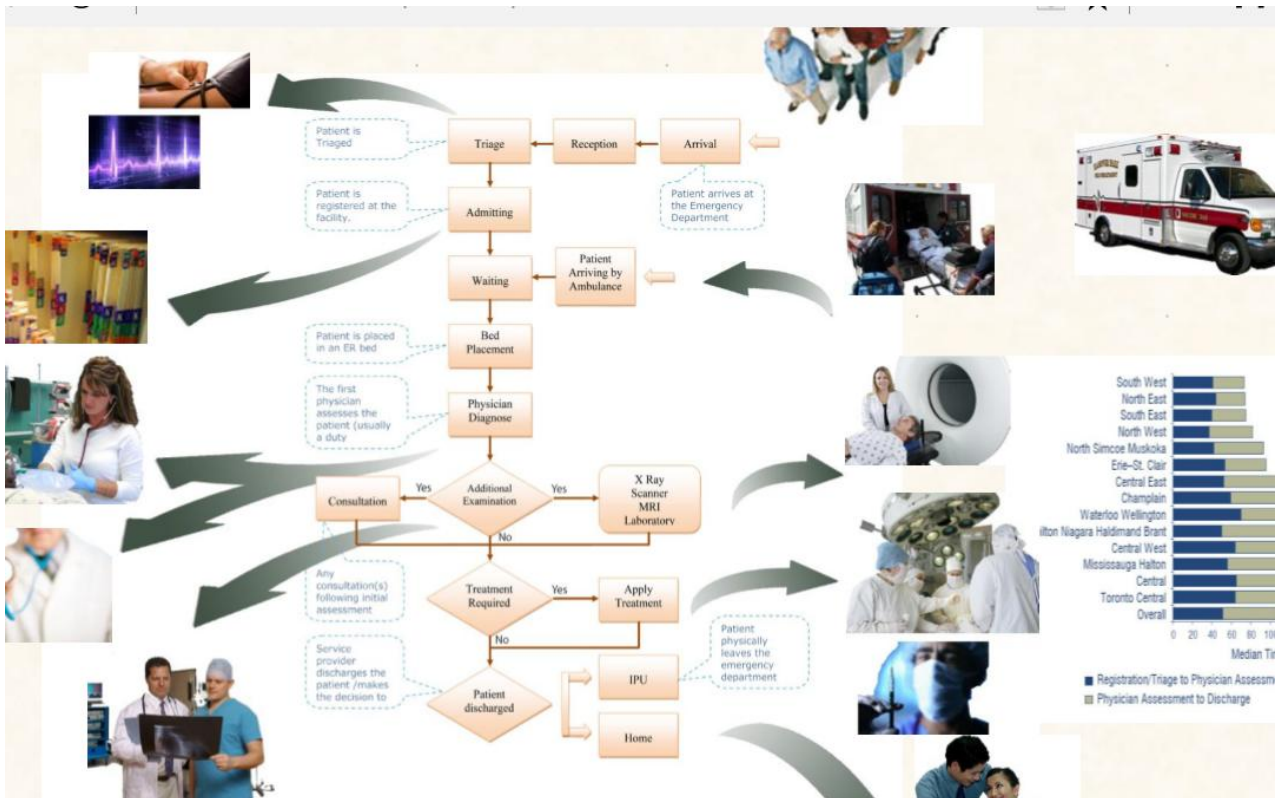


Figure 6.1 The patient flow in emergency services[9]

2.3.1 Emergency Department Characteristics

Characteristics of an Emergency Department that make it a unique environment and present design challenges include: □

- The changing models of care within Emergency Departments and the emergence of associated and co-located inpatient departments; □
- The varying levels of staff associated with certain models of care; □
- The varied case mix of acutely unwell patients who are often suffering from time critical and life threatening illnesses;
- □ The role of the Emergency Department/hospital e.g. whether it functions as a major trauma service; □
- The presentation of patients with undifferentiated conditions; □
- The presence of patients, relatives, carers or friends who are stressed and anxious; □

- The presence of patients suffering from an acute psychosocial crisis; □
- The high patient turnover; □
- The varied patient admission and discharge pathways;
- □ The ‘front loading of patient care’ by health professionals primarily stationed in the ED, rather than in the ward, in order to expedite their care;
- The Emergency Department providing a growing number of unique and important services, mostly by specialist Emergency Physicians.[7]

2.4 Emergency Department Design

The design of an efficient Emergency Department in which care is coordinated and carried out in an appropriate environment depends on the productive collaboration between a number of key stakeholders involved in the building or redevelopment process. The process of Emergency Department design should consider: □

a)Functionality – an Emergency Department’s design needs to be practical and reflect how health professionals manage and treat their patients who have different clinical conditions;

b)Form – spatial considerations and relationships that promote effective interaction between staff and patients, relatives, carers, and the flow of clinical care. Consideration that Emergency Department models of care will change over time is needed, as well as consideration of the relationship between the Emergency Department and the greater hospital. Over time, clinical treatment spaces will be reallocated, so many spaces need to have flexibility built into them to ensure future proofing.[7]

C)Patient and staff needs – the aim of health care is not only to treat disease, but also to create a healing environment for patients that is safe and free of psychosocial elements created through poor design. Additionally, the workplace needs of Emergency Department staff can be promoted through the application of Occupational Health and Safety (OH&S) standards that ensure a work environment that is as safe as possible. The psychosocial wellbeing of staff should be considered through design and space use. This should not be underestimated given that staff will

occupy the Emergency Department spaces much longer than any patient, relative or carer. (Emergency Department Design Guidelines) (G15) 6 of 77 Pitfalls Common pitfalls encountered by clinical user groups in the Emergency Department design process include: Inadequate briefing of the redevelopment parameters at the outset of the project; Poor project governance e.g. inconsistent clinical user group and planning staff leadership, representation, project involvement, and project meeting attendance. One implication of this is that key decisions need to be revisited at later dates or building requirements are overlooked or misunderstood; An inadequate period of protected, dedicated time at the project outset to ensure that key decisions are adequately considered; A lack of opportunity to visit and discuss the pros and cons of other recently constructed or redesigned Emergency Departments, both locally and overseas; A lack of resources and understanding of built environment research and evidence based design; A lack of mechanisms to engage with clinical staff with previous experience in Emergency Department design projects, and who have the ability to assist, review and mentor key clinical design decisions; Not considering how adherence to the Disability Discrimination Act (DDA) and other relevant legislation will impact on Emergency Department design; and Clinical practice, information technology and design not being considered in totality, resulting in the development of a new facility but with no change in clinical practice and inadequate infrastructure for IT, or a lack of space for equipment.[5]

The purpose of the Emergency Department is to receive, triage, stabilise and provide acute health care to patients. This includes patients requiring resuscitation and those with emergent, urgent, semi-urgent and lessurgent conditions (Australasian Triage Scale (ATS) categories 1-5 [2]). An Emergency Department also requires the capacity to deal with mass casualty and disaster situations. There are particular patient types seen in the Emergency Department that may have specific psychosocial and treatment needs. These include:

- Major trauma patients;
- Elderly patients;
- Children and adolescents;
- Patients with physical and mental disabilities;

- Victims of child abuse, domestic violence, or sexual assault;
- Patients with mental health issues; □
- Patients with infectious diseases or who are immunocompromised; □ Custodial patients;
- Patients affected by chemical, biological or radiological contaminants.[7]

2.4 Equipment planning:

An equipment list showing all items of equipment necessary to operate the facility shall be included in the contract documents. This list will assist in the overall coordination of the acquisition, installation, and relocation of equipment.

Space for accessing and servicing fixed and building service equipment shall be provided.

2.4.1 Building Service Equipment:

Building service equipment shall include such items as heating, air conditioning, ventilation, humidification, filtration, chillers, electrical power distribution, emergency power generation, energy/utility management systems, conveying systems, and other equipment with a primary function of building service.[5]

2.4.2 Fixed Equipment (Medical and Non-medical) :

Fixed equipment includes items that are permanently affixed to the building or permanently connected to a service distribution system that is designed and installed for the specific use of the equipment. Fixed equipment may require special structural designs, electromechanical requirements, or other considerations.

a. Fixed medical equipment includes, but is not limited to, such items as fume hoods, sterilizers, communication systems, built-in casework, imaging equipment, radiotherapy equipment, lithotripters, hydrotherapy tanks, audiometry testing chambers, and lights.

b.Fixed non-medical equipment includes,but is not limited to,items such as walk-in refrigerators,kitchen cooking equipment,serving lines,conveyors,mainframe computers,laundry,and similar equipment.[5]

2.4.3 Movable Equipment (Medical and Non-medical)

Movable equipment includes items that require floor space or electrical and/or mechanical connections but are portable,such as wheeled items, portable items,office-type furnishings,and diagnostic or monitoring equipment.Movable equipment may require special structural design or access, electromechanical connections,shielding,or other considerations.

a.Movable medical equipment includes,but is not limited to,portable X-ray,electroencephalogram (EEG),electrocardiogram (EKG),treadmill and exercise equipment,pulmonary function equipment,operating tables,laboratory centrifuges,examination and treatment tables,and similar equipment.[5]

b.Movable non-medical equipment includes,but is not limited to,personal computer stations,patient room furnishings,food service trucks,case carts and distribution carts,and other portable equipment.[5]

c.Facility planning and design shall consider the convenient and dedicated placement of equipment requiring floor space and mechanical connections and the voltage required for electrical connections where portable equipment is expected to be used.An equipment utility location drawing shall be produced to locate all services required by the equipment.[5]

Chapter Two

Theoretical Fundamentals

Chapter Three: Background Studies

In this chapter some studies will be represented as the following, the research and scientific papers in common, that all work to manage the design of emergency facilities and improvement of the current situation.

Irish Association of Emergency Medicine in (2007) , have drawn upon International ED Design and Specification Guidelines from the UK, the USA and Australasia to develop guidelines appropriate to modern Irish Emergency Medicine.

Patient care in the ED is uniquely time-dependent. The length of time spent by patients waiting for, or receiving care, the number of patients attending and the scope of services offered will influence the design requirements for each department.

These guidelines for ED design, allied with improvements in ED staffing, safety and service delivery will support the provision of the highest possible standards of care for patients who attend Irish EDs. EDs are designated clinical areas in which patients receive immediate and urgent care, ideally provided by specialists in Emergency Medicine, with support from other specialties as required. This involves the diagnosis and management of a broad spectrum of undifferentiated acute illness and injury, including both physical and behavioural disorders. ED design is influenced by the needs of patients, ED staff requirements and the characteristics of Emergency Medicine

In Their Design they suggest Where possible natural (ambient) light should be used and colour schemes chosen should be appropriate given the stressful environment of many, if not all, EDs. EDs need to be placed in an area of the hospital that is easily accessible to Emergency vehicles entering the site. The ED must have ready access to those critical care areas and diagnostic facilities necessary for modern Emergency Medicine to be practiced. Infrastructural requirements can be considered in terms of clinical areas (including direct clinical care and clinical support areas) and non-clinical areas.

Good infrastructural design is critical to effective patient care. Lack of appropriately placed storage facilities, for example, can result in difficulty accessing vital

equipment and avoidable delays in patient care or inappropriate storage can interfere with hygiene in clinical areas.

The defined the following Clinical areas; Patient access: (Ambulance facilities ,Ambulance entrance ,Ambulance equipment storage area ,Decontamination area ,Walking entrance ,Reception area). Patient care areas: (Triage area ,Ambulance patient triage area ,Waiting room,Paediatric waiting area ,Sub-wait areas ,Resuscitation area ,Isolation rooms (negative pressure rooms) ,Treatment area / Majors area / Urgent area ,Special function treatment rooms ,Ambulatory care area / Minors area ,Nurse Practitioner area ,Paediatric treatment areas (incl. Adolescent Crisis Suite) ,Interview rooms for social care ,Therapies area ,Quiet rooms / Disturbed patient rooms ,Patient toilets (waiting room / treatment areas)

Baby changing and breast feeding facilities)

Inpatient facilities: (Observation Ward / Clinical Decision Unit, Chest Pain Assessment Unit ,Relatives interview room for in-patients ,Staff duty base

Inpatient showers and toilets).

Clinical Support Areas :(Reception area ,Drug Preparation areas ,Drug Storage areas ,Equipment storage ,Portable x-ray equipment storage ,Staff duty base ,Communications base ,Near-patient testing area ,Supplies storage area ,Medical gas storage area ,Cleaner's room ,Clean and Dirty utility areas

Major Incident Storage area ,Security area ,Laboratory specimen transport system , Spare trolley storage area)

Non-clinical areas: (Staff facilities: Staff changing rooms ,Staff shower and toilets ,Staff dining area)

Office accommodation:(Administrative support ,Multi-person offices Individual offices).

Education and training facilities :(Seminar room, Library/ computer access

Storage area)

Support services: (Switch cupboard ,Area for fire alarm control board Electrical systems ,IT equipment ,CCTV system equipment).

The overall size of the ED will depend on the volume and scope of services

provided. It is not the overall department floor space which is important but the space critical to the efficient functioning of the services provided (i.e. the critical dimension).Undoubtedly, the design of EDs contributes significantly to whether or not patient “flow” is facilitated or obstructed. Greater care needs to be taken to ensure that department design maximises efficiency and minimises the number of conflicting patient journeys.

Design should accommodate existing and anticipated staff and patient work-flows and processes. Work-flow analysis and modelling based upon peak and average attendances and duration of ED care episodes may be helpful early in the design stage. The needs of attendant and ambulance staff moving patients on trolleys must be considered. Door specifications should facilitate ease of movement of patients on trolleys. Automatic door opening systems are essential for trolley movement.

All corridors and entrances or exits should allow two trolleys to pass

unhindered.Preparation and planning are crucial to the success of an ED design process. [7]

Australian college of emergency medicine (2007), They designed these guidelines to assist clinicians, planners and architects in producing a design for an emergency department which is of adequate size and contains adequate facilities to fulfill its role. As emergency departments have high patient turnover, varied casemix and a large workforce, their design is crucial to their function. Emergency departments must be planned with due consideration for the potential for growth and expected changes in health care delivery. Current and potential models of care must be considered.

Key considerations include safety and security, amenity, access, image and consumer expectations, and evolving work practices.

In order to maximise functional consideration, it is recommended that The clinical areas be designed to accommodate higher acuity patients, All treatment spaces should be wired for monitoring with access to the patient available from all sides ,

Paediatric clinical spaces require as a minimum the same space requirements if not more than adult patient care spaces to accommodate family members and /or carers, storage area for toys, books etc, The department design has the ability to respond to clinical demands, The central station or 'arena' department design concept is appropriate to a certain department size. When this is exceeded modular design principles should be adopted to maximise operational practices ie. Sub grouping patient care areas each with ready access to its own clinical support areas and its own central station to avoid staff fragmentation ,Overuse of speciality rooms be avoided. Maintain flexibility to cope with emerging advances in clinical care ie. staff access to computer wireless technology in clinical recording ,Spatial consideration be made to accommodate family members and/or carers who will be accompanying the patient, Privacy and confidentiality be maximised ,The clinical areas have the capacity to be isolated to prevent cross infection or cross contamination in the event that an area becomes contaminated .This should allow rapid access to every space with a minimum of cross traffic. There should be close proximity between the Resuscitation/Acute Treatment areas for non-ambulant patients and other treatment areas for ambulant patients, as staff may require relocation at times of high workload.

Once designed, the plan should be tested by using a number of clinical scenarios ie. multiple trauma, chest pain, paediatric resuscitation, mental health presentation with a behavioural problem, gynaecological presentation, potentially infectious or poisoned patients ie. MRSA, TB, SARS, "white powder", fracture, malaria, to ensure optimal patient flow.

The total internal area of the emergency department, excluding observation ward and internal medical imaging area if present, should be at least 50m²/1000 yearly attendances or 145m²/1000 yearly admissions, whichever size is greater. The minimum size of a functional emergency department that can incorporate all of the major areas is 700m².^[8]

The following diagram outlines the various pathways that a patient may follow when (s)he enters the emergency department:

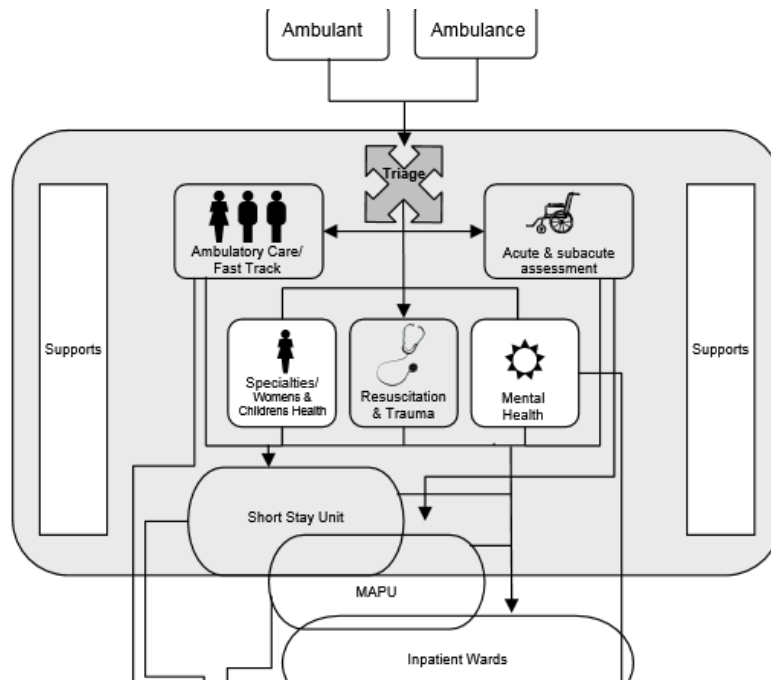


Figure 3.1: Diagram shows the flow of patients in the emergency department. [8]

Jeff Ferenc on July 1, 2011, the number of free-standing emergency departments (EDs) operated by hospitals continues to grow as health care facilities contend with challenges caused by the shrinking number of emergency rooms while patient demands for emergency service soar.

The number of hospital-based EDs has declined by 27 percent over a 20-year period ending in 2009, while the number of visits to hospital EDs increased to an all-time high of 123 million in 2008, states a recent report by the Journal of the American Medical Association.

It's no surprise that in 2007 emergency rooms at about half of U.S. hospitals operated at or beyond capacity, according to an American Hospital Association (AHA) report. To cope with the demand for emergency service, hospitals in at least 16 states have opened free-standing EDs, the California Health Care Foundation reports.

In 2009, there were 241 community hospital-affiliated free-standing EDs, or 5.9 percent of all community hospitals, according to the AHA. That's an increase of about 25 percent over the 179 free-standing EDs operated by community hospitals in 2006, say AHA officials.

While free-standing EDs originally functioned as a way to serve patients in rural or inner-city areas that can't support a full hospital, hospitals typically are opening new facilities in urban or suburban areas. The purpose is twofold: It can improve emergency care by reducing patient wait times plus it helps the hospital market its brand and capture new patients.

Free-standing emergency departments tend to be very successful, which indicates many patients find value in the service, which is sometimes faster than regular emergency departments. [9]

Dr. M. Al-Hussein and Dr. S. Al-Jibouri ,their design objectives were to reduce the waiting in emergency departments, Achieve a reduction in average LOS, Identify the processes that add value to the patient's experience , Eliminate waste , Assess ED architectural & engineering standards on the basis of patient-focused environment
□ “Universal Zero Delay Treatment”

The method used is

- a) A statistical analysis and survey of 42 ED designs
- b) An ED process design change
- c) Incorporating new design principles

Simulation Model Outcomes and Recorded Improvements :

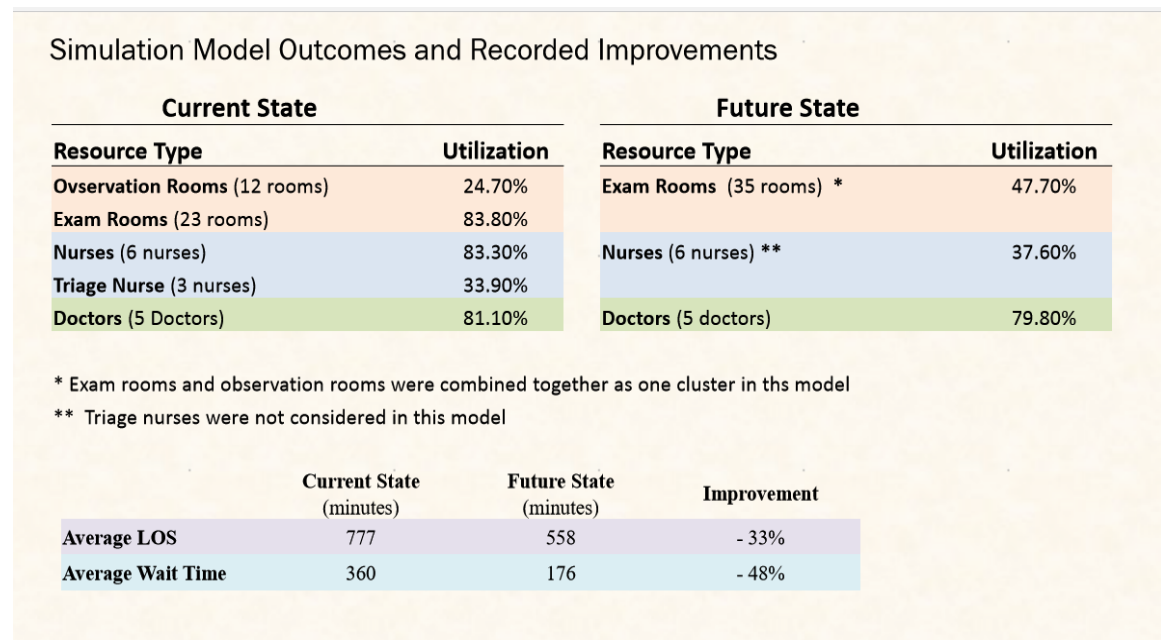


Figure (3.2): design outcomes and improvements

Achieved : □ A Streamlined Design , □ A reduction in average LOS , □ Value added processes □ Inter departmental process flow , □ Waste reduction □ , The architectural and engineering standards .[9]

Amanda Ampt et al.,(2008) their study approved that the design of a hospital has impact on potential health outcomes for patients and staff.

These include: Potential health outcomes for patients

- Sleep disturbance associated with excessive noise potentially leading to increased morbidity, delirium and agitation
- Increased pain as a result of excessive noise; and pain reduction with exposure to sunlight and provision of a window with a view
- Fewer post surgical complications (leading to reduced length of hospital stay) and less boredom associated with provision of a window with a view of nature or everyday activities/life outside

Risk of hearing loss among premature babies as a result of excessive noise

- Risk of increased medical error resulting from communication difficulties amongst

staff as a result of excessive noise, and from inadequate procedural lighting

- Poorer communication with staff as a result of lack of privacy and confidentiality associated with open bay environments
- Improvement in mood for depressed patients with associated reduction in length of hospital stay when exposed to morning light; and reduction in agitation for patients with Alzheimer's Disease when exposed to a constant level of light intensity
- Maintenance of Circadian Rhythm when exposed to normal day/night light cycle with better sleep, increased weight gain for premature babies, and decreased risk for "ICU psychosis" for those in intensive care environments
- Risk of vitamin D deficiency associated with inadequate exposure to daylight
- Reduced mortality post myocardial infarction associated with exposure to sunlight
- Risk of poor health impacts (depression, passivity, reduced immune function and agitation) associated with loss of control and removal of normalcy
- Better cognitive functioning associated with presence of windows
- Heightened sense of wellbeing with design that encourages presence and involvement of family members, with specific health outcomes for neonates (such as increased breastfeeding) when family members play an active role
- Decreased risk of medication errors and patient falls with introduction of acuity adaptable rooms, associated with better staff surveillance with associated decentralisation of nurses' stations and supply areas
- Decreased agitation and aggressive behaviour amongst psychogeriatric patients when they had free access to outdoor areas; with self-reported positive mood changes in the general patient population associated with access to garden areas

Potential health outcomes for staff

- Increased stress levels, burn-out and emotional exhaustions associated with excessive noise
- Decreased self-reported stress associated with exposure to a minimum of three hours natural light per day, and by visiting the hospital garden
- Decreased tiredness, headaches and sore throats with reduction in sick leave associated with installation of full spectrum lighting and indoor green plants
- Headaches associated with excessive noise and artificial lighting.[11]

Chapter 4

Methodology and Data Analysis

Chapter 4: Methodology and Data Analysis

4.1 Methodology:

This chapter defines the methods conducted in this study in order to achieve all the information and data from the emergency departments so that help to understand how things going.

The methods used were qualitative and quantitative methods .

In qualitative method interviews were held with selective doctors and administrators from different emergency departments in different hospitals,data obtained was personnel ,descriptive and individual opinions of the interviewers.

In the quantitative method questionnaire used to evaluate the current situation and problems faced in the emergency department in Sudan ,also to collect the numerical data that will be used in the design.

The goal of this methodology is to approve the need of the separate accident and emergency hospital .

4.2 Data collection

Data collected by visiting some of emergency departments and asking the staff there about problems that they are facing in their work.

The survey (Attachment) assessed the following areas:

- Hospital types and hospital capacity
- Hospital emergency services available
- Emergency Department bed capacity □
- Maximum Intensive Care Unit (ICU) capacity
- Percentage of certified/eligible physicians □
- Availability of equipments
- Patient access

- Emergency department's design problems

4.3 Data analysis

The survey used a quantitative scale (e.g., available services, percentage of certified physicians) together with qualitative measures to get a more global picture of a hospital's overall readiness and desire to pursue a separated emergency and trauma hospital designation. Most categories were weighted to a scale (percentage) of 100 for ease of comparisons. By weighting the scores it was possible to compare a facility that lacks ancillary services (e.g., physical therapy, social services, lab or x-ray), but meets or exceeds the subspecialty physician services, with another facility that has the required ancillary services, but is deficient in most or all subspecialty physician services (e.g., orthopedics, neurosurgeon, urologist).

The questionnaire has the following parts :

1. Basic information
2. Emergencies
3. Equipment
4. Ancillary services
5. Personal input and opinion

4.4 Data analysis:

Part (1): Basic Information

Table 4.1 : Hospital type

Valid	Frequency	Percent
Public	20	43.5%
Private	16	34.8%
Military	10	21.7%
Total	46	100.0%

This question shows the hospital types, 43.5% of the total visits were public hospitals, 34.8% were private hospitals and 21.7% were military hospitals as shown in figure

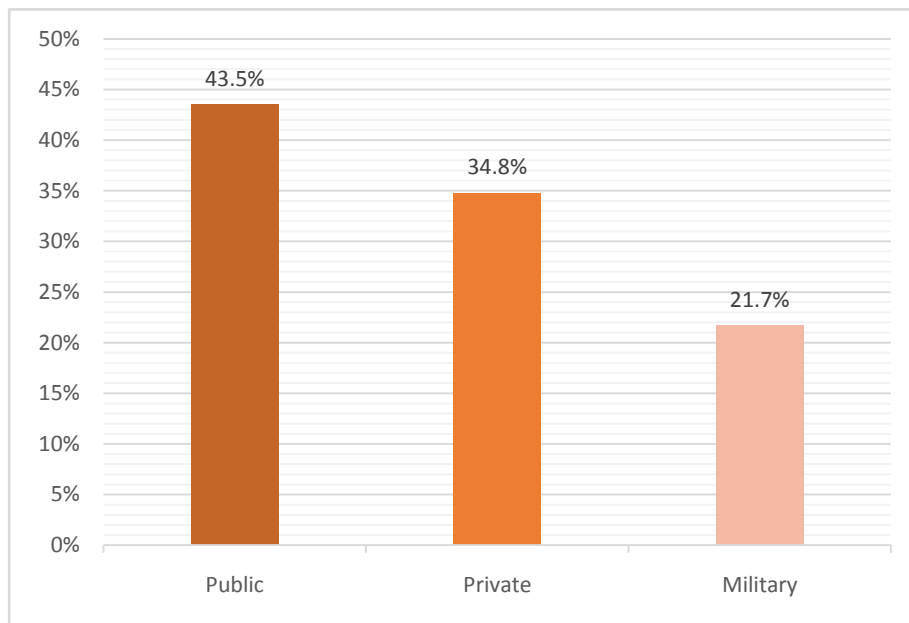


Figure (4.1): Hospital type

Table (4.2) : Numbers of beds

	Frequency	Percent
50 - 100	22	47.8%
150 - 200	18	39.1%
250 - 300	6	13.0%
Total	46	100%

This section illustrate the number of beds in each hospitals,47.8% of the hospital have beds in range from 50 -100 beds,39.1% have number of beds in the range 150-200 beds,and 13% have beds from 250-300 beds.this shown in figure (4.2) below.

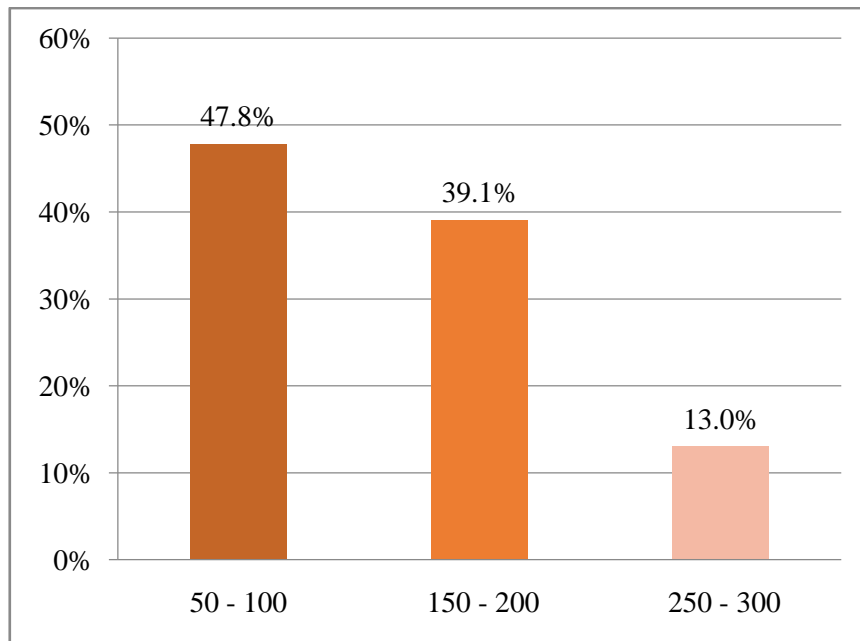


Figure (4.2): Numbers of beds

Table 4.3: Emergency Department Capacity

Valid	Frequency	Percent
5 - 10	28	60.9%
20 - 30	9	19.6%
40 - 50	9	19.6%
Total	46	100.0%

This question about emergency departments capacity ,60.9% of the answers in the range 5-10 beds ,19.6 % were in the range 20-30 and 19.6% of the answers were in the range 40-50 .this shown in figure (4.3) below.

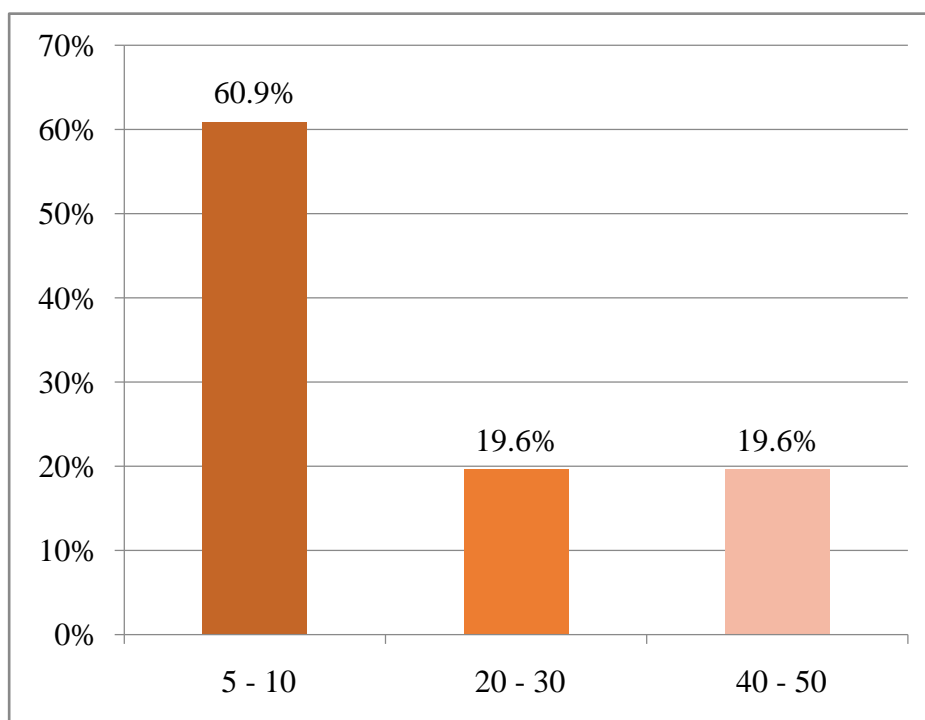


Figure 4.3: Emergency Department Capacity

Table 4. 4 :Departments working hours

Valid	Frequency	Percent
Yes	46	100.0%
No	0	0%
Total	46	100.0%

The table above showing the working hours of departments,100% of the answers were 24 hours working hours.This shown below in figure (4.4) .

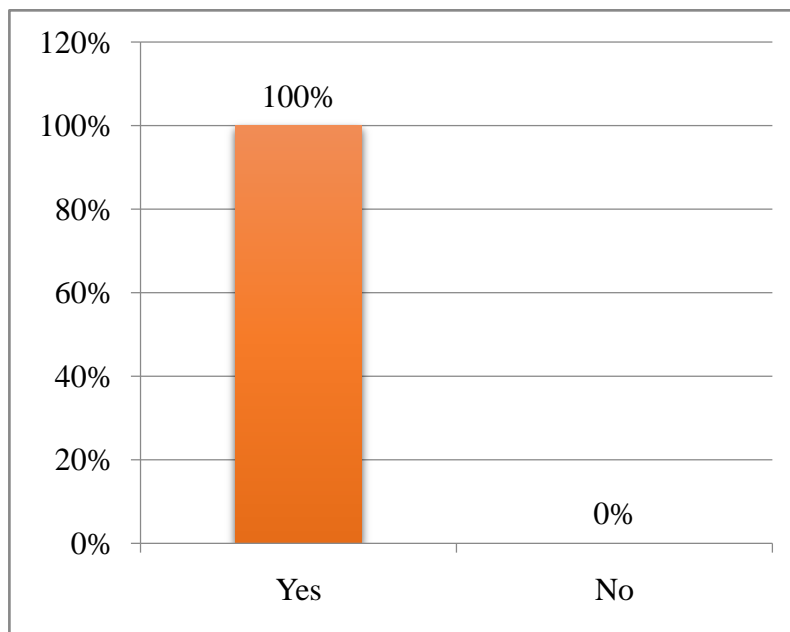


Figure (4): Departments working hours

Table (4.5) :patient types treated

Valid	Frequency	Percent
Yes	39	84.8%
No	7	15.2%
Total	46	100.0%

The table above shows the weather the department treat all patient types or no,84.8% of answers were yes and 15.2% of answers were no.as shown in figure(4.5) below.

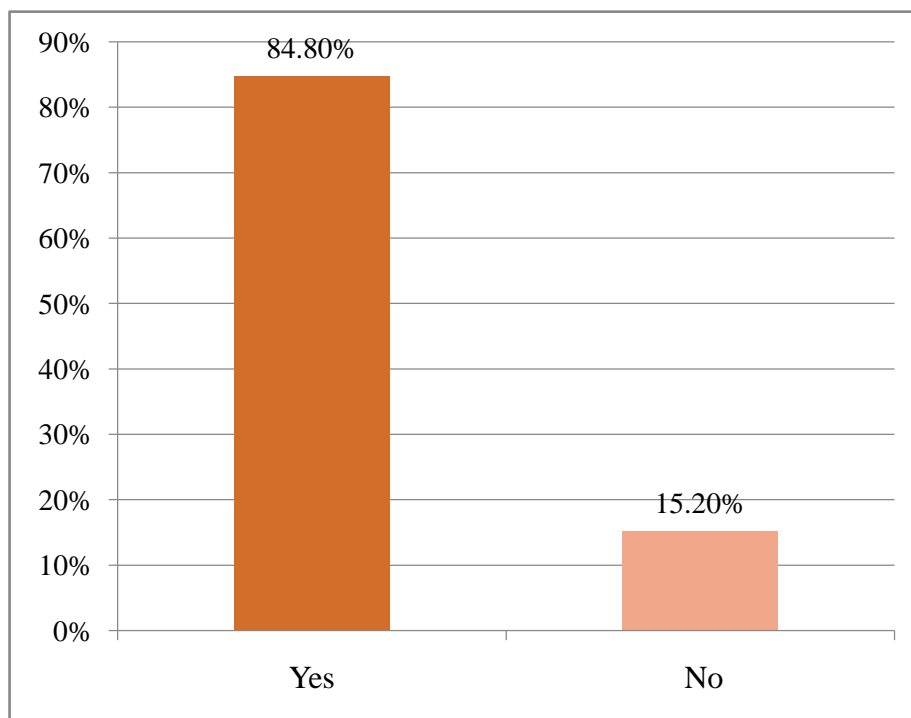


Figure 4.5: Types of patient treated

Table (4.6): The patients access

Valid	Frequency	Percent
Ambulance	6	13.0%
Private transport	36	78.3%
Others	4	8.7%
Total	46	100.0%

This section about how patients access the emergency department ,13% of answers were ambulance ,78.3% were private transport and 8.7% answers were others.this shown in figure (4.6) below.

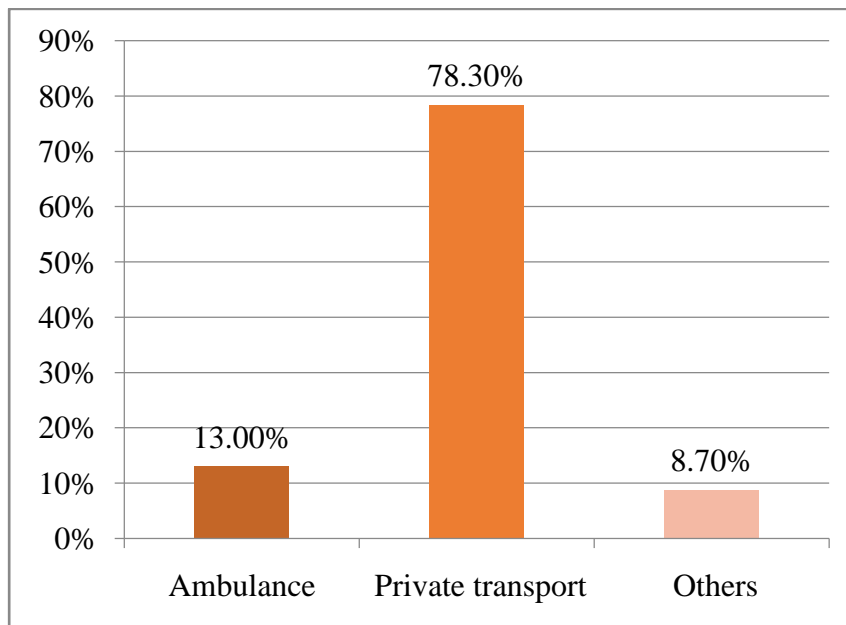


Figure (4.6): The patients' access

Table 4.7 : Ambulance availability

Valid	Frequency	Percent
Yes	25	54.3%
No	21	45.7%
Total	46	100.0%

The table above shows whether department have it's own ambulance or not ,54.3% of answers were yes and 45.7% of answers were no.this shown in figure 4.7 below.

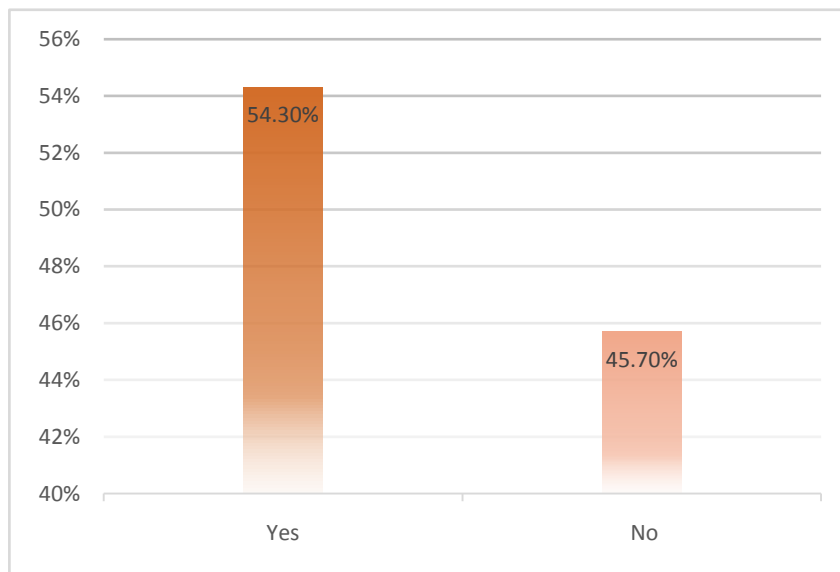


Figure (4.7) : Ambulance availability

Part (2): Emergencies

Table 4.8 :Triage system

Valid	Frequency	Percent
Yes	29	63%
No	17	37%
Total	46	100%

In this section question about triage system ,63% of answers were yes and 37% of the answers were no .this is shown in figure (4.8) below.

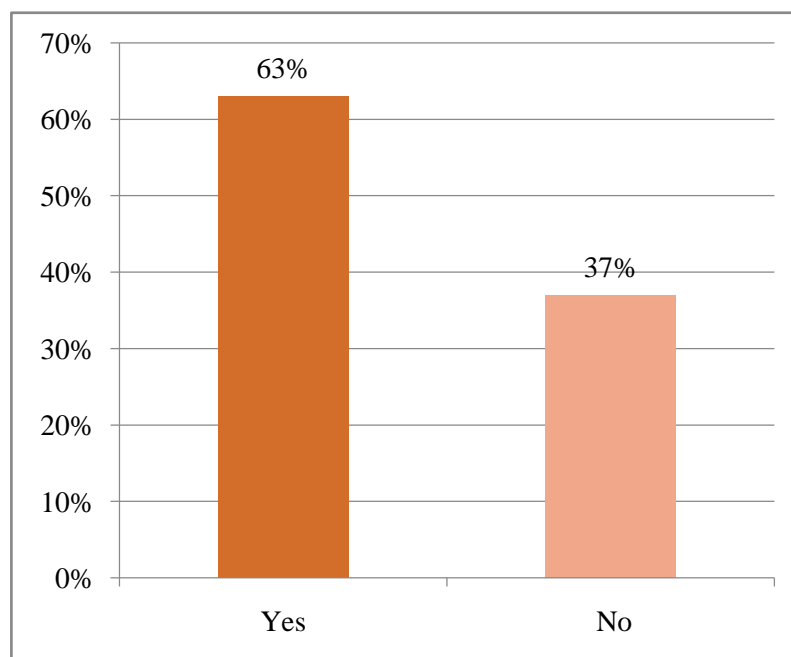


Figure 4.8: Triage system of departments

Table (4.9) :Multi cases handling

Valid	Frequency	Percent
Yes	38	82.6%
No	8	17.4%
Total	46	100.0%

This table above illustrate whether the departments handle many cases at once ,82.6% of answers were yes and 17.4% of answers were no.as shown in figure (4.9)below.

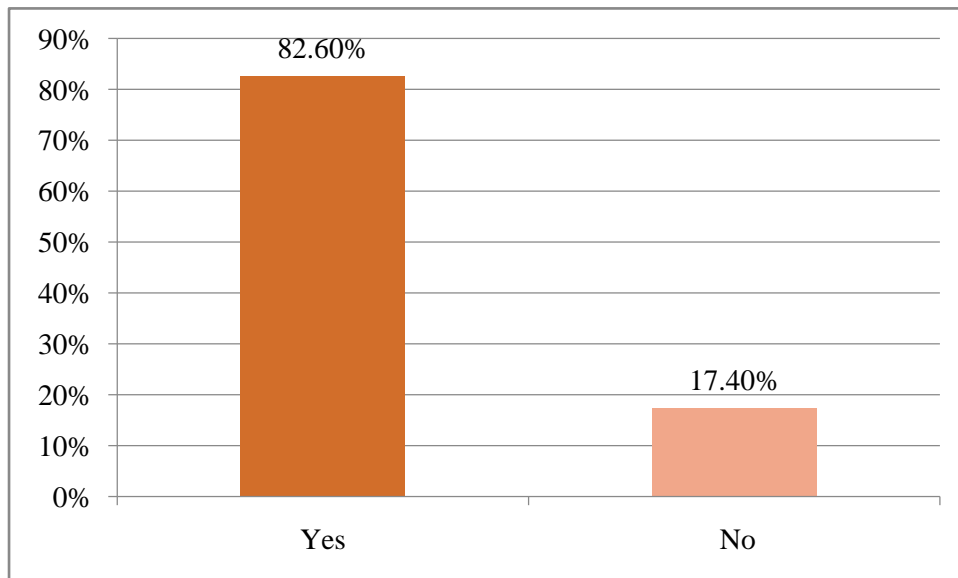


Figure (9): Multi cases handling

Table 4.10 : Cardiac Emergency

Valid	Frequency	Percent
Yes	40	87.0%
No	3	6.5%
some times	3	6.5%
Total	46	100.0%

Table above show that 87% have emergency for cardiac ,6.5% have no emergency for cardiac and 6.5 % answers were some times .as shown in figure (4.10) below.

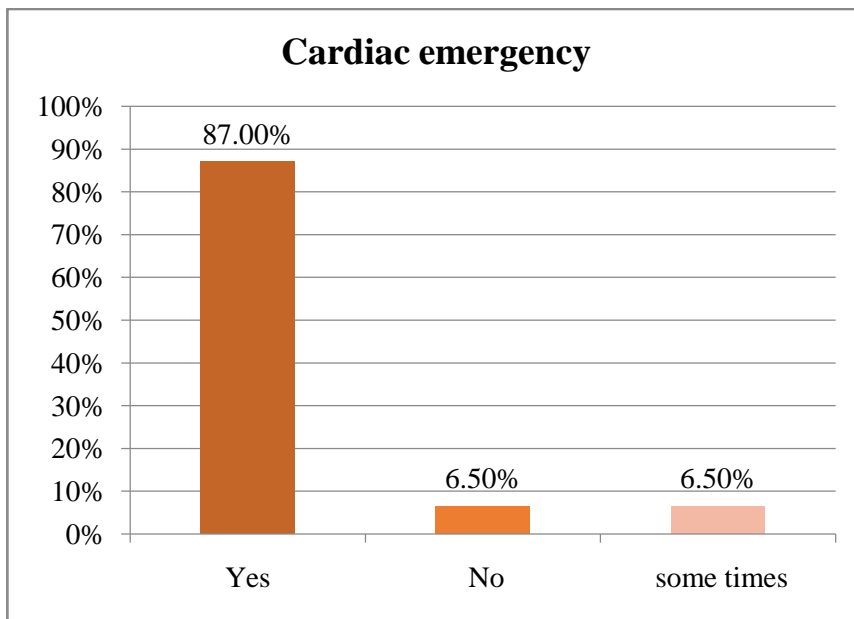


Figure (10): Cardiac emergency availability

Table (4.11): Obstetric Emergency Availability

Valid	Frequency	Percent
Yes	17	37.0%
No	22	47.8%
some times	7	15.2%
Total	46	100.0%

Table above show that 37% have emergency for Obstetric ,47.8% have no emergency for Obstetric and 15.2 % answers were some times .as shown in figure (4.11) below.

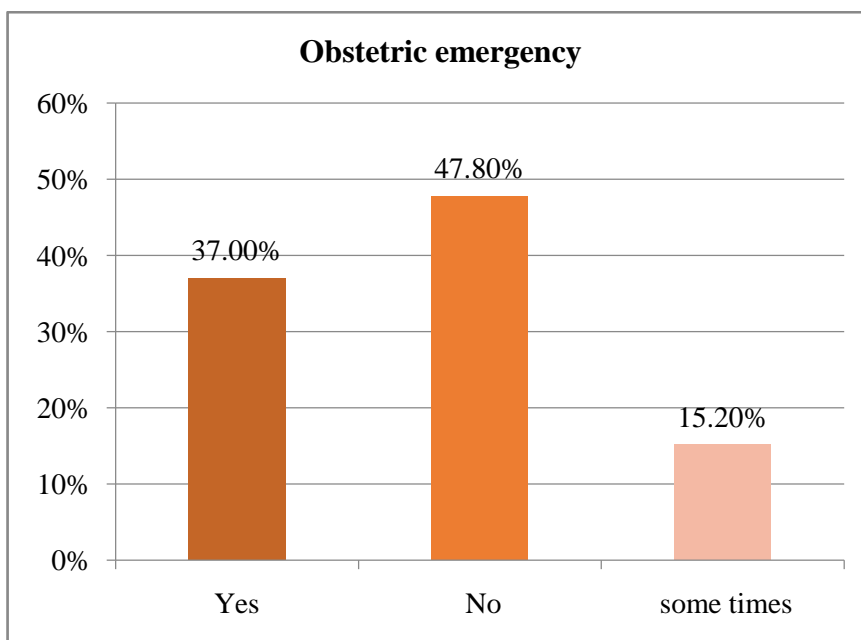


Figure (4.11): Obstetric Emergency Availability

Table (4.12): Ophthalmic emergency availability

Valid	Frequency	Percent
some times	4	8.7%
Yes	21	45.7%
No	21	45.7%
Total	46	100.0%

Table above show that 8.7% have emergency for Ophthalmic,45.7% have no emergency for ophthalmic and 45.7 % answers were some times .as shown in figure (4.12) below.

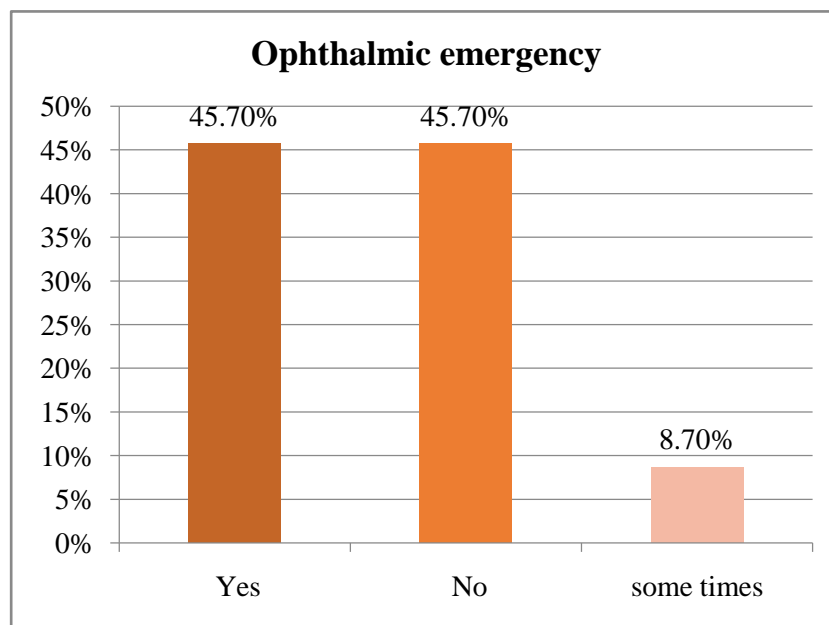


Figure 4.12: Ophthalmic emergency availability

Table (4.13): Orthopaedic emergency

Valid	Frequency	Percent
Yes	33	71.7%
No	12	26.1%
some times	1	2.2%
Total	46	100.0%

Table above show that 71.7% have emergency for Orthopaedic ,26.1% have no emergency for Orthopaedic and 2.2 % answers were some times .as shown in figure (4.13) below.

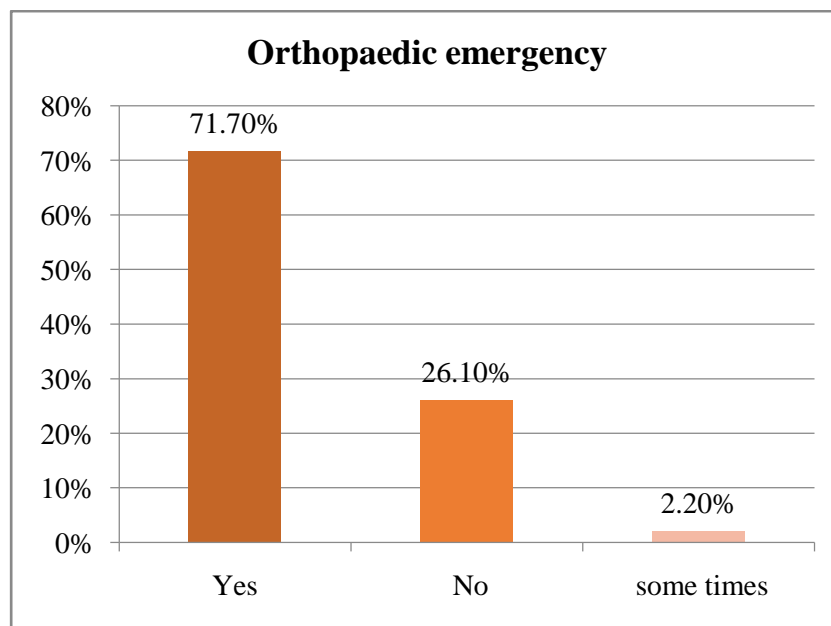


Figure 4.13: Orthopaedic emergency availability

Table (4.14):Burns emergency

Valid	Frequency	Percent
Yes	29	63.0%
No	13	28.3%
some times	4	8.7%
Total	46	100.0%

Table above show that 63% have emergency for burns,28.3% have no emergency for burns and 8.7% answers were some times .as shown in figure (4.14) below.

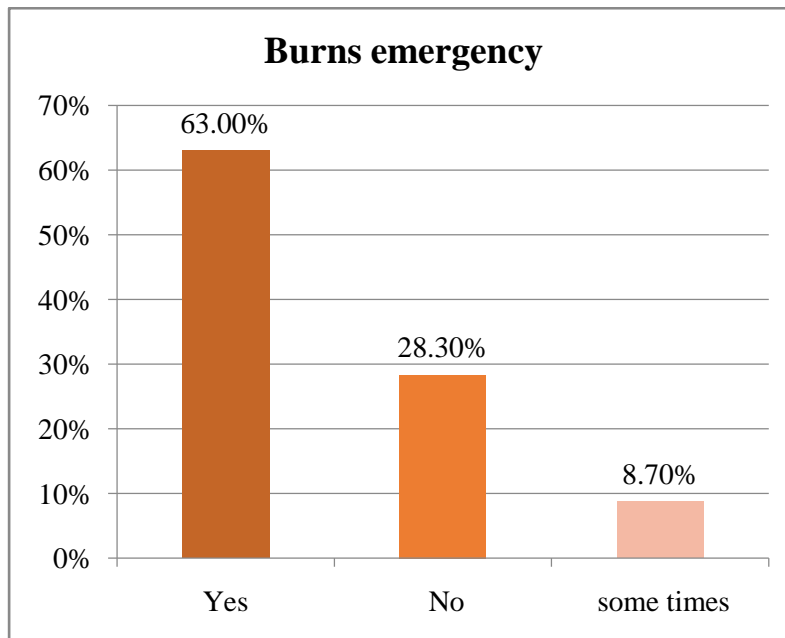


Figure (4.14): Burns emergency availability

Table (4.15):Paediatric emergency

Valid	Frequency	Percent
Yes	33	71.7%
No	8	17.4%
some times	5	10.9%
Total	46	100.0%

Table (4.15)above show that 71.7% have emergency for paediatric ,17.4% have no emergency for paediatric and 10.9% answers were some times .as shown in figure (4.15) below.

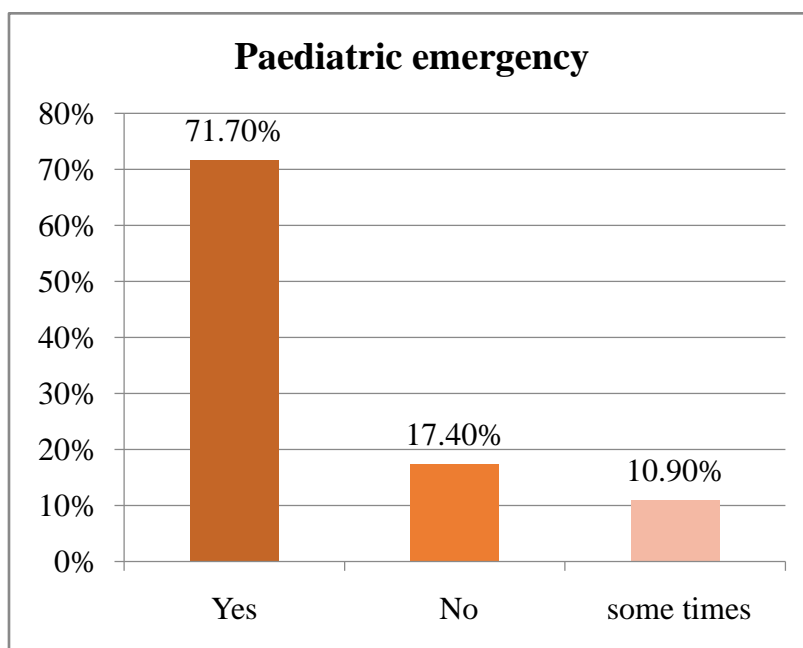


Figure (4.15): Paediatric emergency availability

Part (3): Equipment

Table (4.16): Department equipped with ECG

Valid	Frequency	Percent
Yes	39	84.8%
No	7	15.2%
Total	46	100.0%

Table (4.16) above illustrate the availability of ECG machine ,84.8% of the answers were yes ,and 15.2% of the answers were no.this shown in figure (4.16) below.

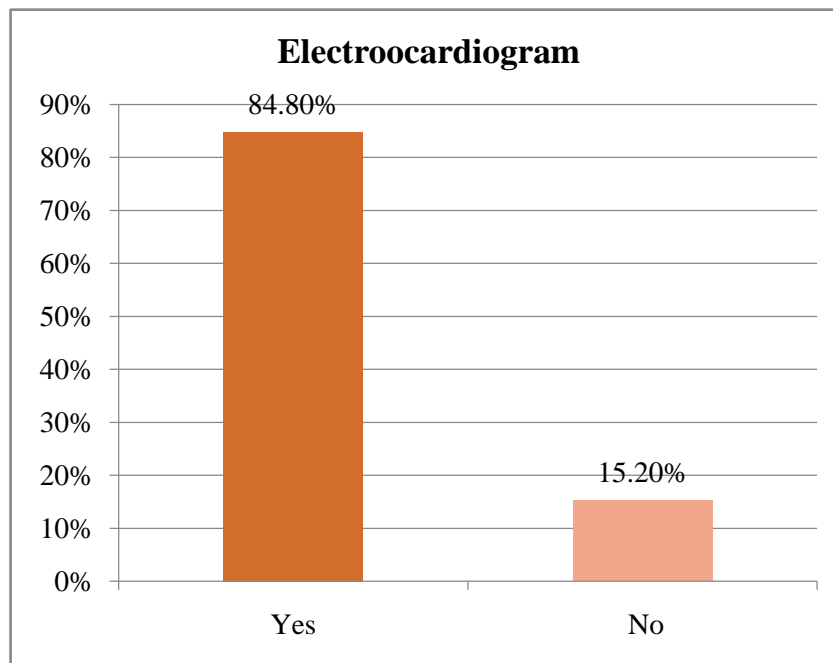


Figure (4.16): Department equipped with ECG

Table (4.17) : Department equipped with defibrillator

Valid	Frequency	Percent
Yes	32	69.6%
No	14	30.4%
Total	46	100.0%

Table (4.16) above illustrate the availability of defibrillator machine ,69.6% of the answers were yes ,and 30.4% of the answers were no.this shown in figure (4.17) below.

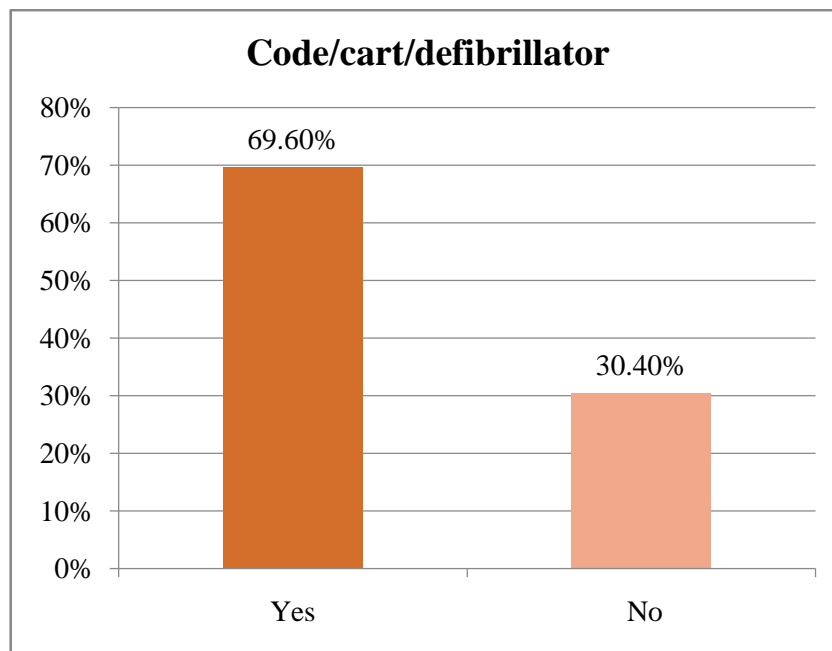


Figure (4.17): Department equipped with defibrillator

Table (4.18):Continues oxygen availability

Valid	Frequency	Percent
Yes	46	100.0%
No	0	0.0%
Total	46	100.0%

Table (4.18) above illustrate the availability of ECG machine ,100% of the answers were yes ,and 0% of the answers were no.this shown in figure (4.18) below.

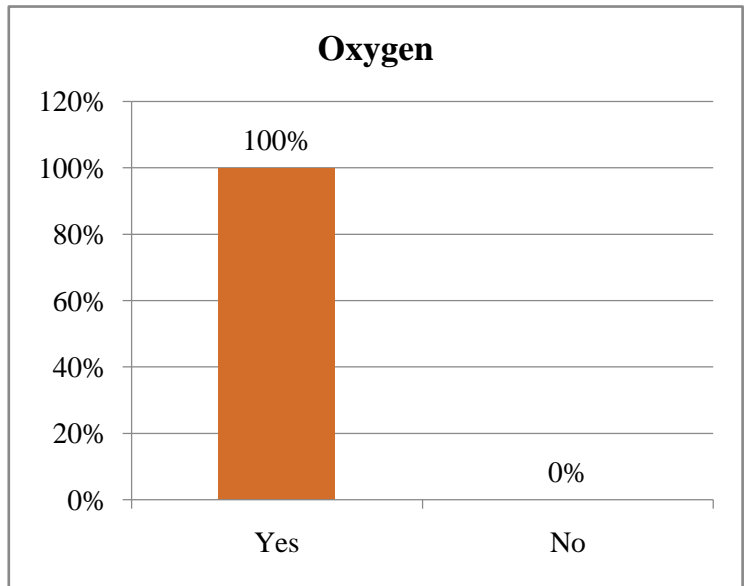


Figure (4.18): Continues oxygen availability

Table (4.19): Departments equipped with Pulse oximeter

Valid	Frequency	Percent
Yes	43	93.5%
No	3	6.5%
Total	46	100.0%

Table (4.19) above illustrate the availability of pulse oximeter ,93.5% of the answers were yes ,and 6.5% of the answers were no.this shown in figure (4.19) below.

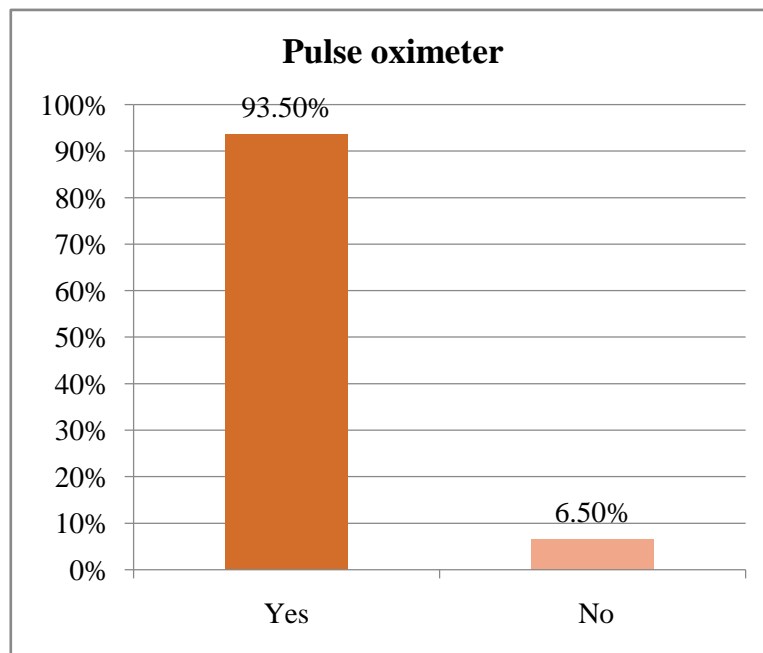


Figure (4.19): Departments equipped with Pulse oximeter

Table (4.20): Departments equipped with X-ray

Valid	Frequency	Percent
Yes	40	87.0%
No	6	13.0%
Total	46	100.0%

Table (4.20) above illustrate the availability of X ray machine ,87% of the answers were yes ,and 13% of the answers were no.this shown in figure (4.20) below.

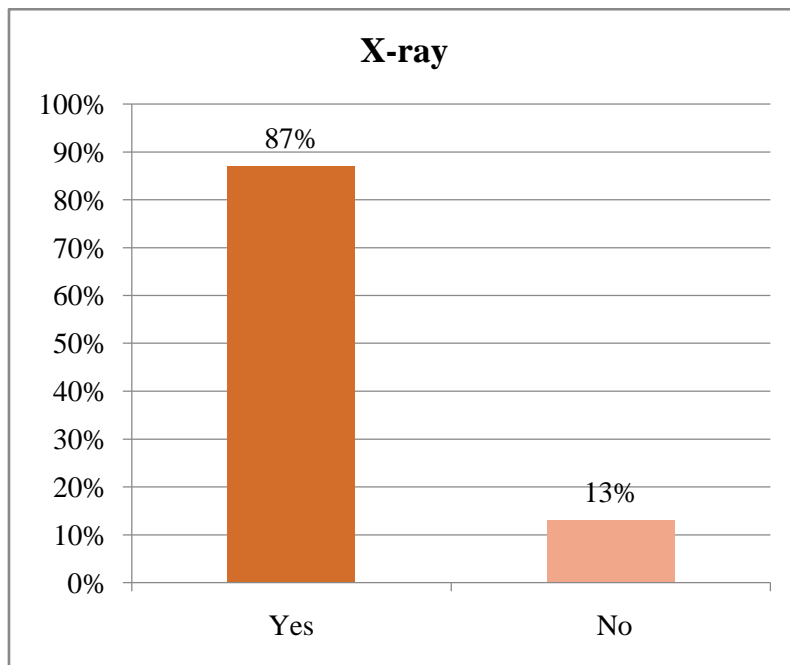


Figure (4.20): Departments equipped with X-ray

Table 4.21: Departments equipped with ultrasound

Valid	Frequency	Percent
Yes	36	78.3%
No	10	21.7%
Total	46	100.0%

Table (4.21) above illustrate the availability of ultrasound machine ,78.3% of the answers were yes ,and 21.7% of the answers were no.this shown in figure (4.21) below.

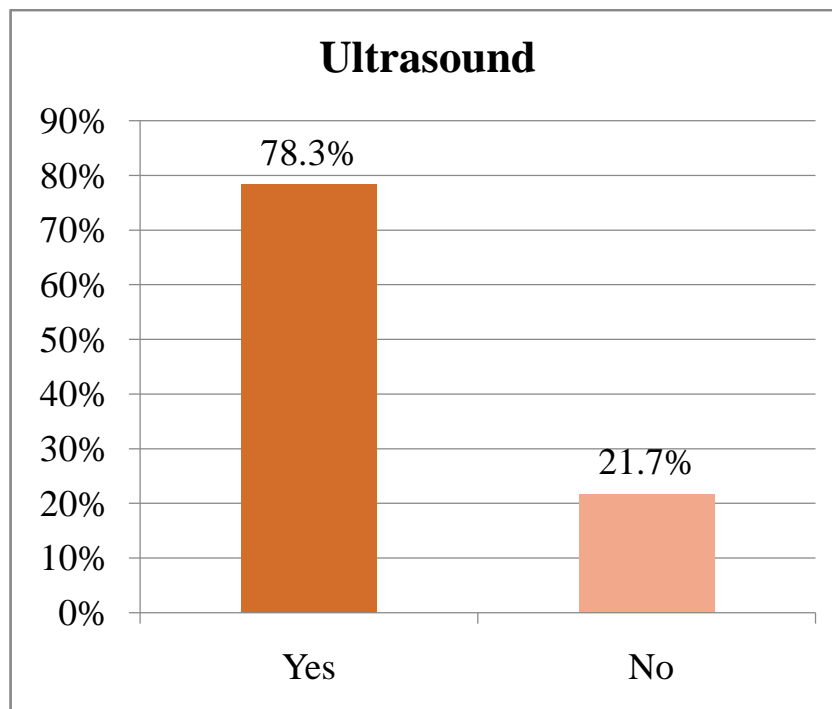


Figure 4.21: Departments equipped with ultrasound

Table 4.22: Departments equipped with CT scan

Valid	Frequency	Percent
Yes	22	47.8%
No	24	52.2%
Total	46	100.0%

Table (4.22) above illustrate the availability of CT scan machine ,47.8% of the answers were yes ,and 52.2% of the answers were no.this shown in figure (4.22) below.

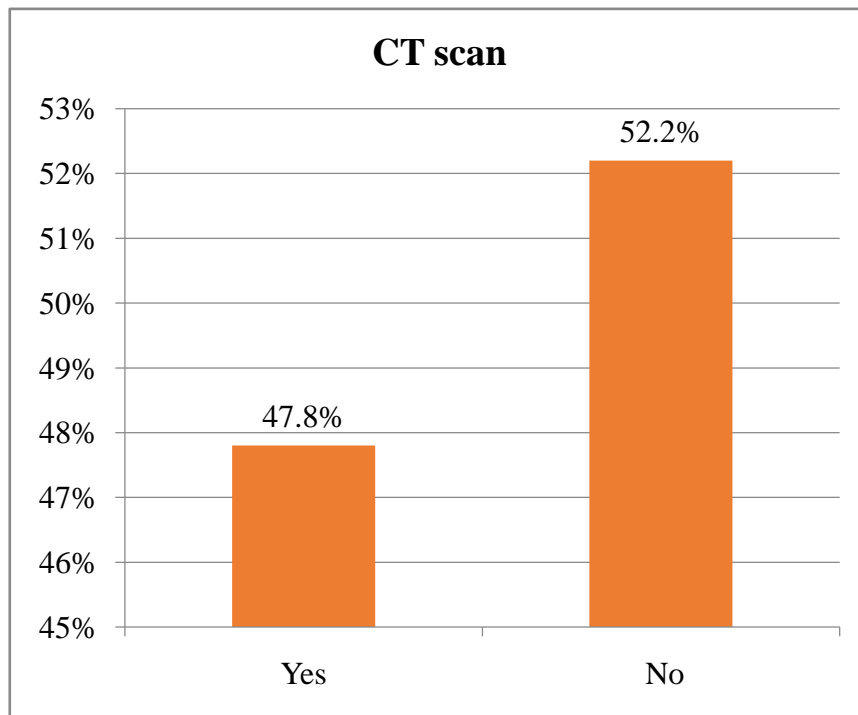


Figure (4.22): Departments equipped with CT scan

Chapter five

Design

Chapter five: Design

The design planning consist of the following steps as shown on figure bellow.

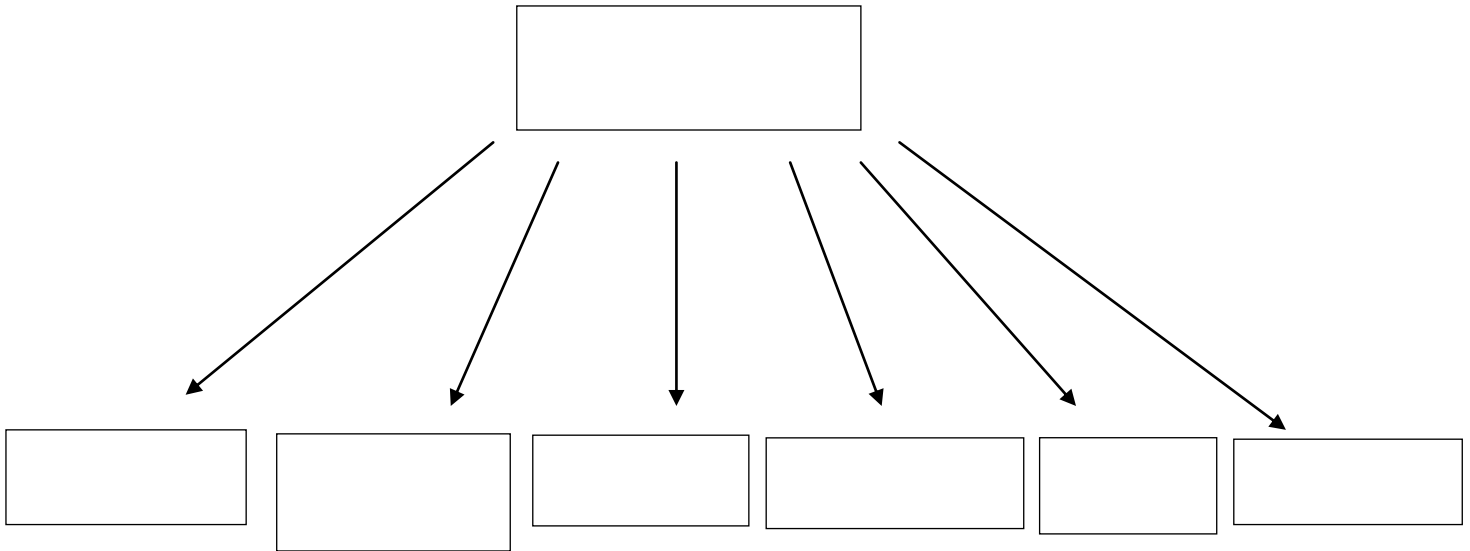


Figure (5.1) : Design Planning steps

5.1 locations

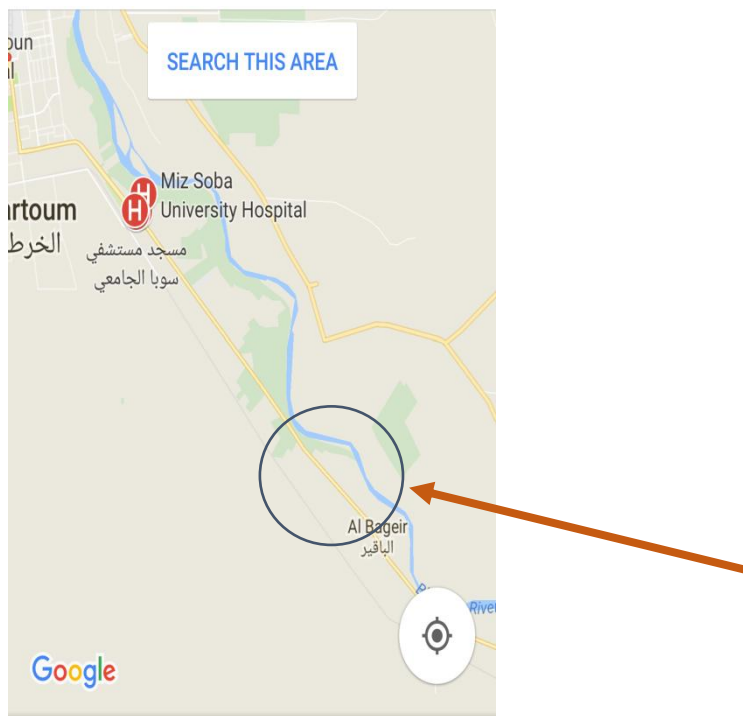


Figure (5.2): shows the suggested area for hospital

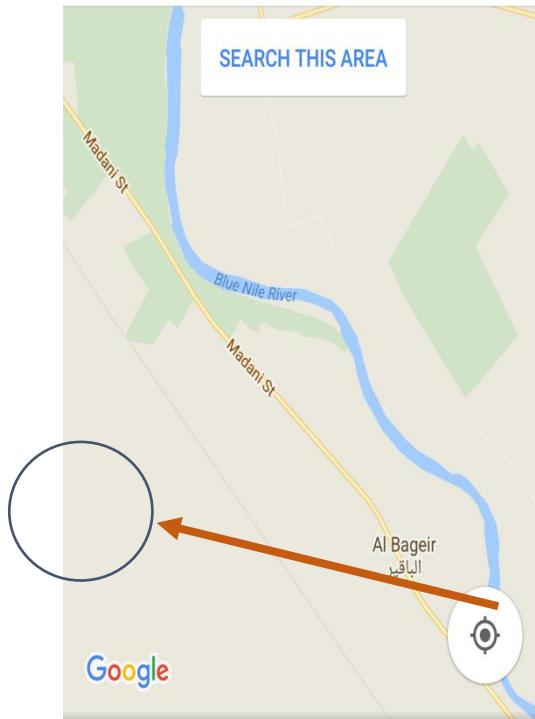


Figure (5.3): the location

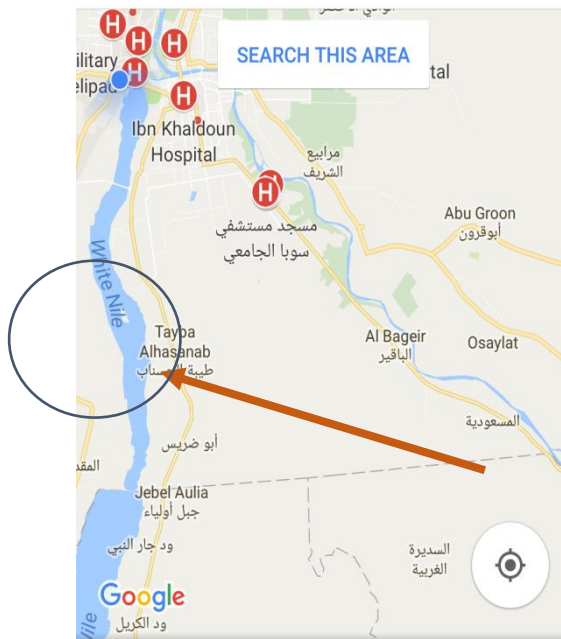


Figure (5.4): Shows that there is no hospital near the suggested area.

5.2 Area

Area required for 250 bed hospital is 15000 square metre (parking excluded).

5.3 Design Plan:

This design is an emergency and trauma hospital designed to improve the emergency services,improve patients safety,Improve patients outcome,Decrease patients length of stay,Reduce patients transfer and Increase patients and staff satisfaction .

5.3.1 Basement floor

All The hospital services located in this floor to be far away from patient area to avoid the noise and protect them from any infection or contamination .

The central sterilization service department (CSSD) is located in the basement in separated area ,designed with one entrance and one exit to insure the the sterile tool has one path from the dirty to the clean area then to the sterile area.

Laundry had space in the basement ,it is one of the important service, since it makes noise also located in the basement.It placed near the CSSD.

Also the central gas station found in this floor to avoid the high sound of machines reach other departments .

There are stores for the clean and sterile tools ,instruments,and clothes.

Other service rooms and stores.

Kitchen also located in this floor in separated area to supply the patient with healthy food under the nutrition observation.As shown below in figure 5.5.

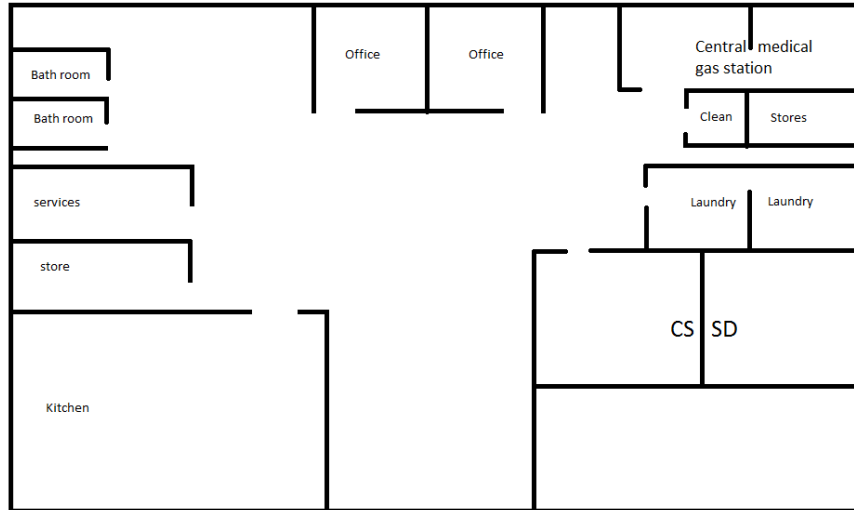


Figure (5.5) : Basement Floor plan

5.3.2 Ground floor:

Mainly consist of the emergency facilities and urgent services which include Reception ,Triage,Waiting area, Resuscitation area,Trauma area ,Treatment area Investigation (radiology department ,laboratory) ,Short stay as shown in figure 5.6 below.

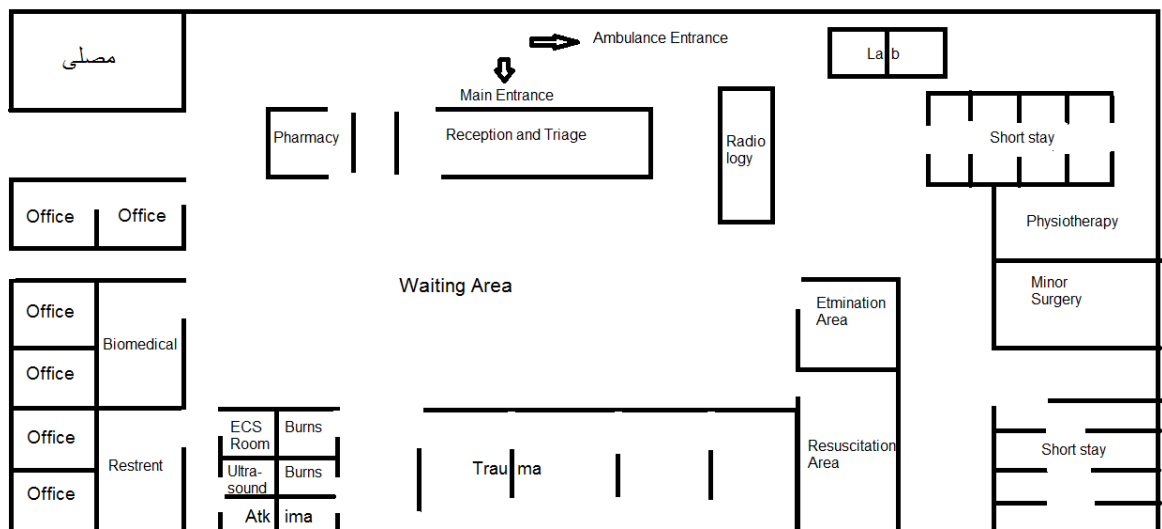


Figure (5.6): Ground Floor plan

5.3.3 First floor

This floor consist of the surgical complex with three major operation rooms ,preparation room,scrubs ,staff changing room and the lounge which located near the operation rooms to allow doctors and staff to take rest during the surgeries .

Also this floor have the Intensive Care Unit and Recovery unit .

Endoscopy room also found in this floor .

The recovery located at the side near to the operation rooms exit to allow the ease of access when moving the patient to the recovery.

The ICU also located beside the recovery to help easy and fast movement.

Coronary Care Unit as shown below in figures (5.7).

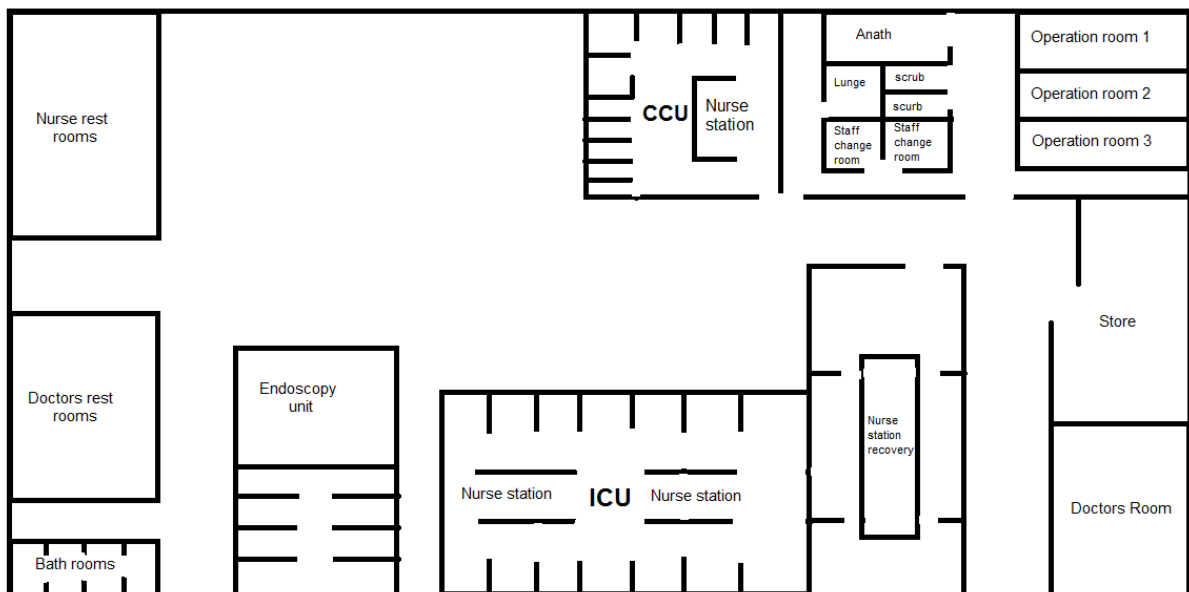


Figure (5.7) : First Floor plan

5.3.4 Second floor :

This floor consists of the obstetric and gynaecology department and its theatre, orthopedic ward, pediatric ward, obs. ward and medicine ward, surgery ward.

The obs theatre located near the elevator to help the emergency case access. Also the delivery rooms are easy to access.

The department has rooms for waiting before and after delivery, as shown below in figure (5.8).

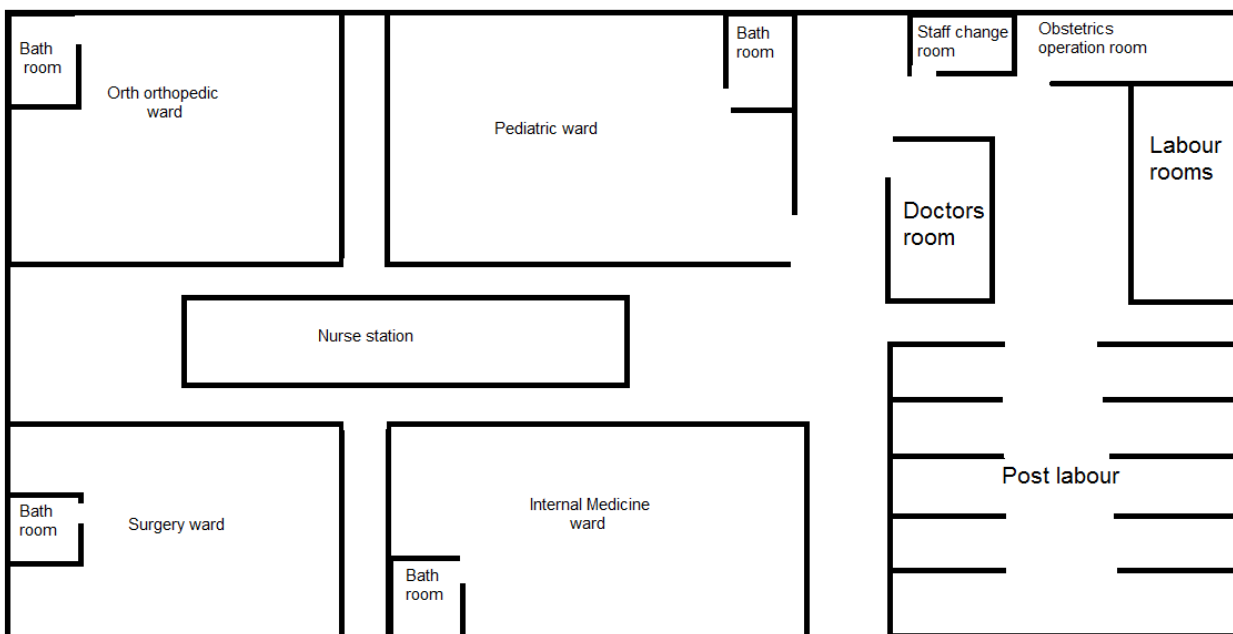


Figure (5.8): Second Floor plan

5.3.5 Third floor

This floor consist of private rooms for patients whose health is stable and still need to recover and to be observed.

There are 43 rooms, 18 have 2 beds and the 25 other rooms have one bed in each.

This is shown in figures (5.9) below .

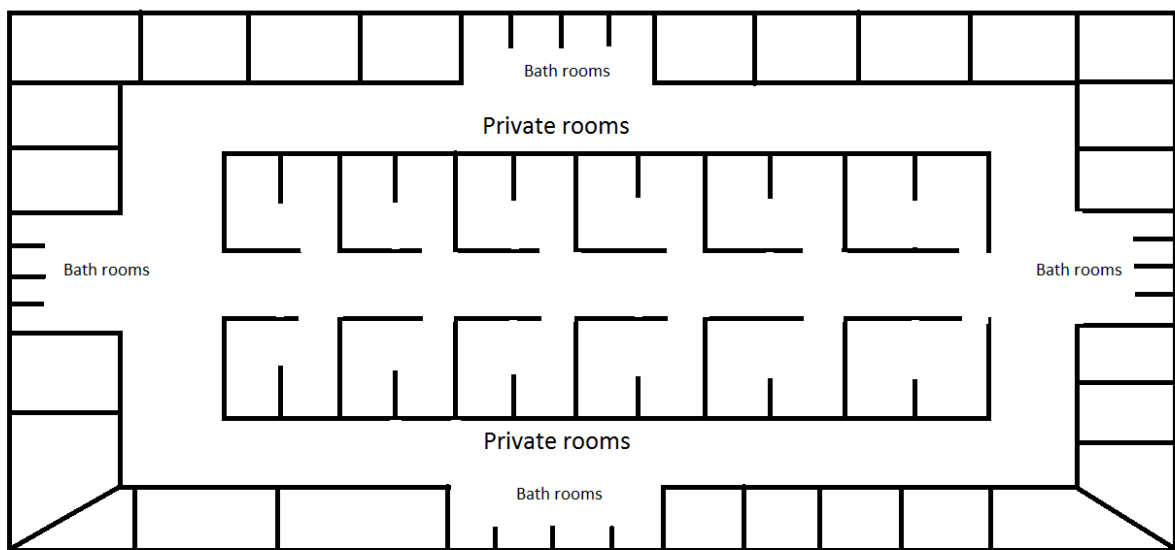


Figure (5.9): Third floor plan

5.4 ARCHICAD

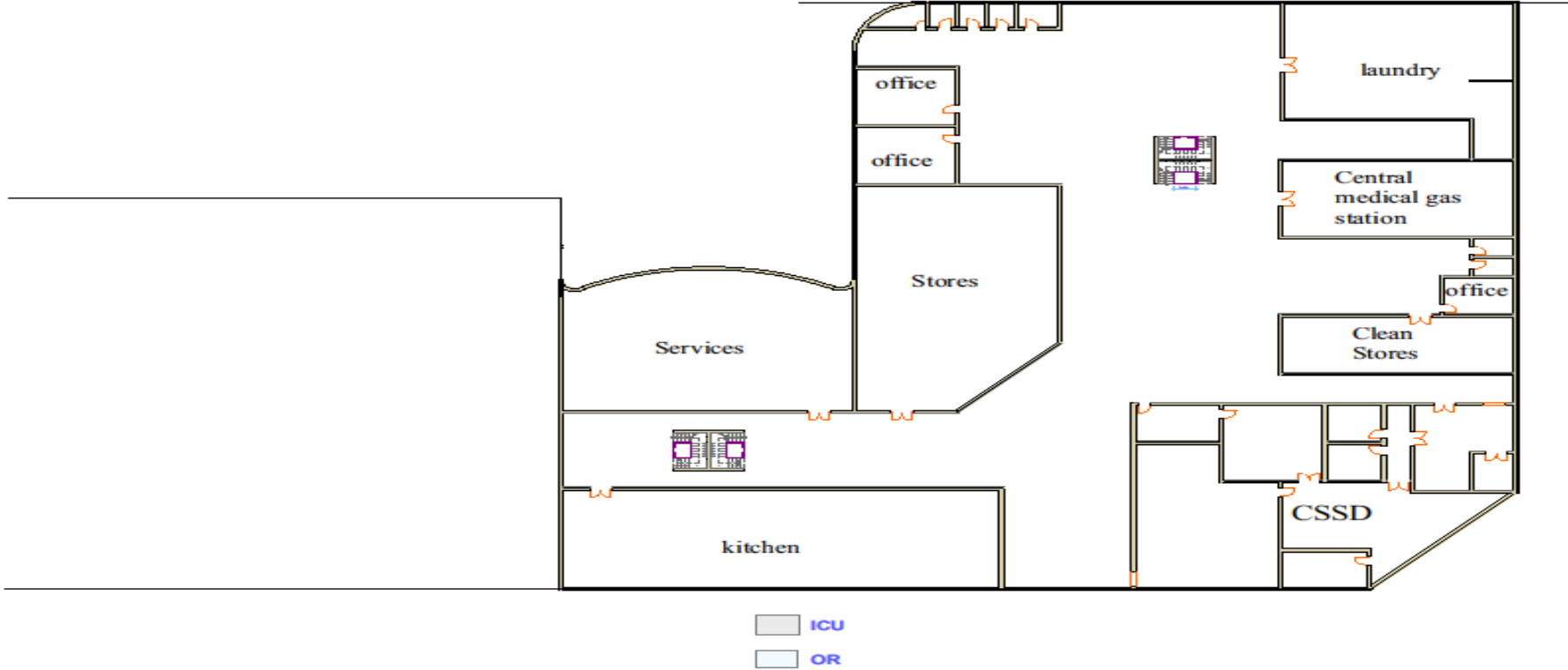


Figure (5.10) : Hospital Basement ARCHICAD Design

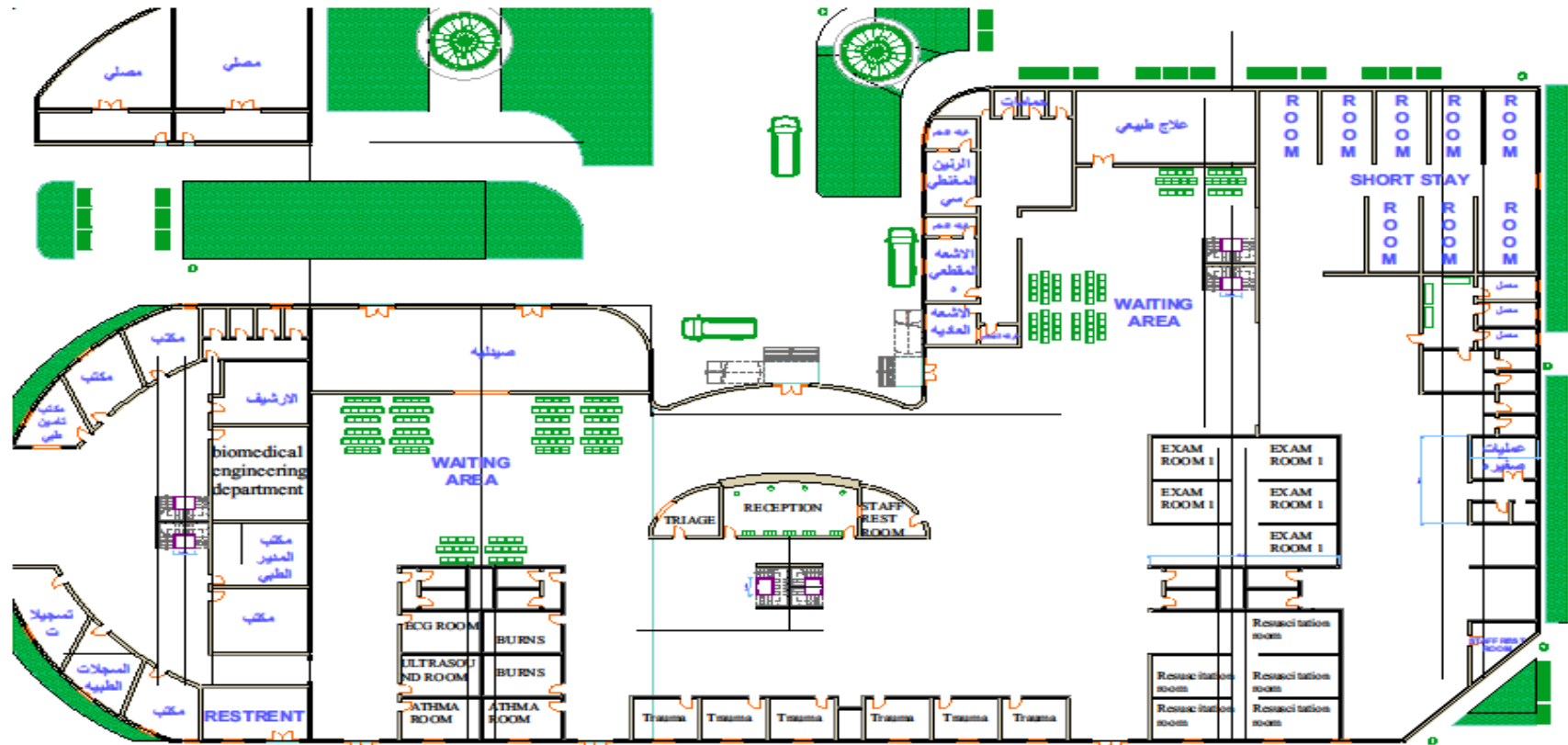


figure (5.11) :hospital ground floor ARCHICAD design

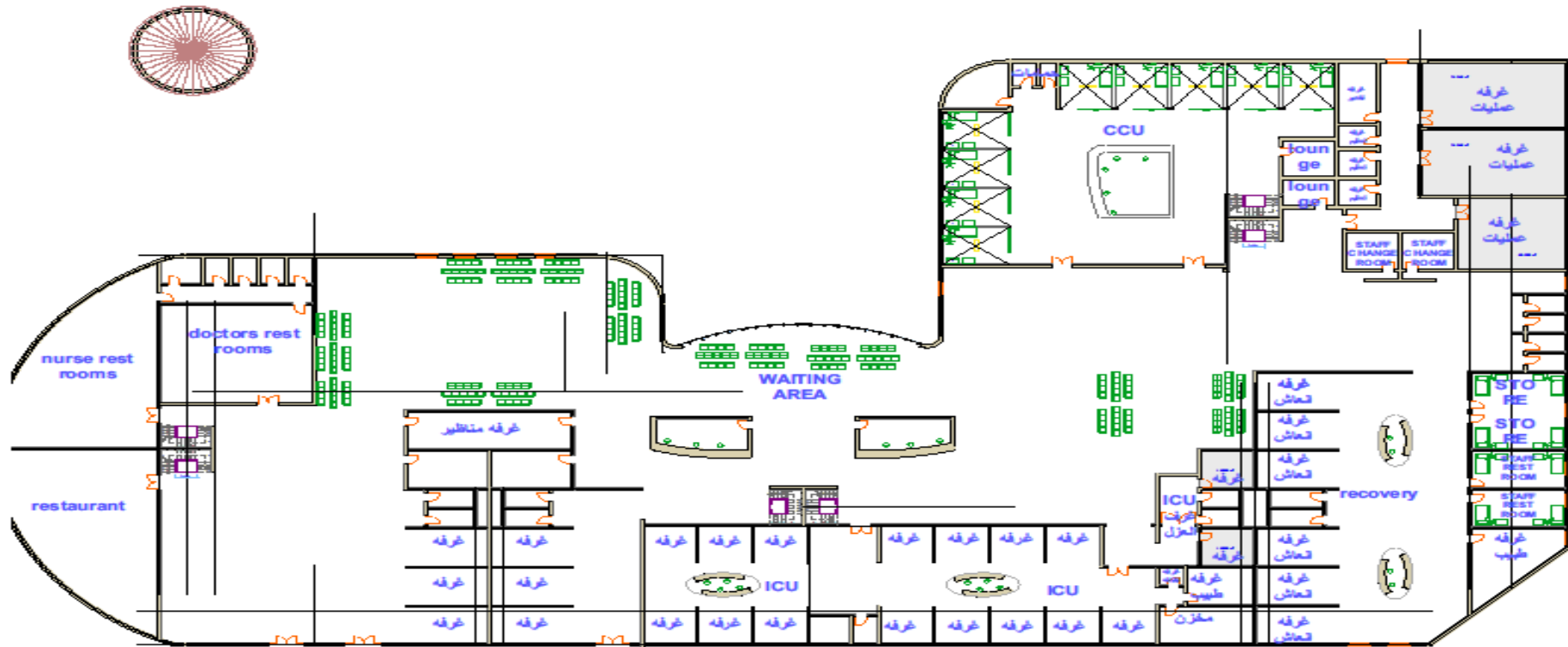


figure (5.12): hospital first floor ARCHICAD design

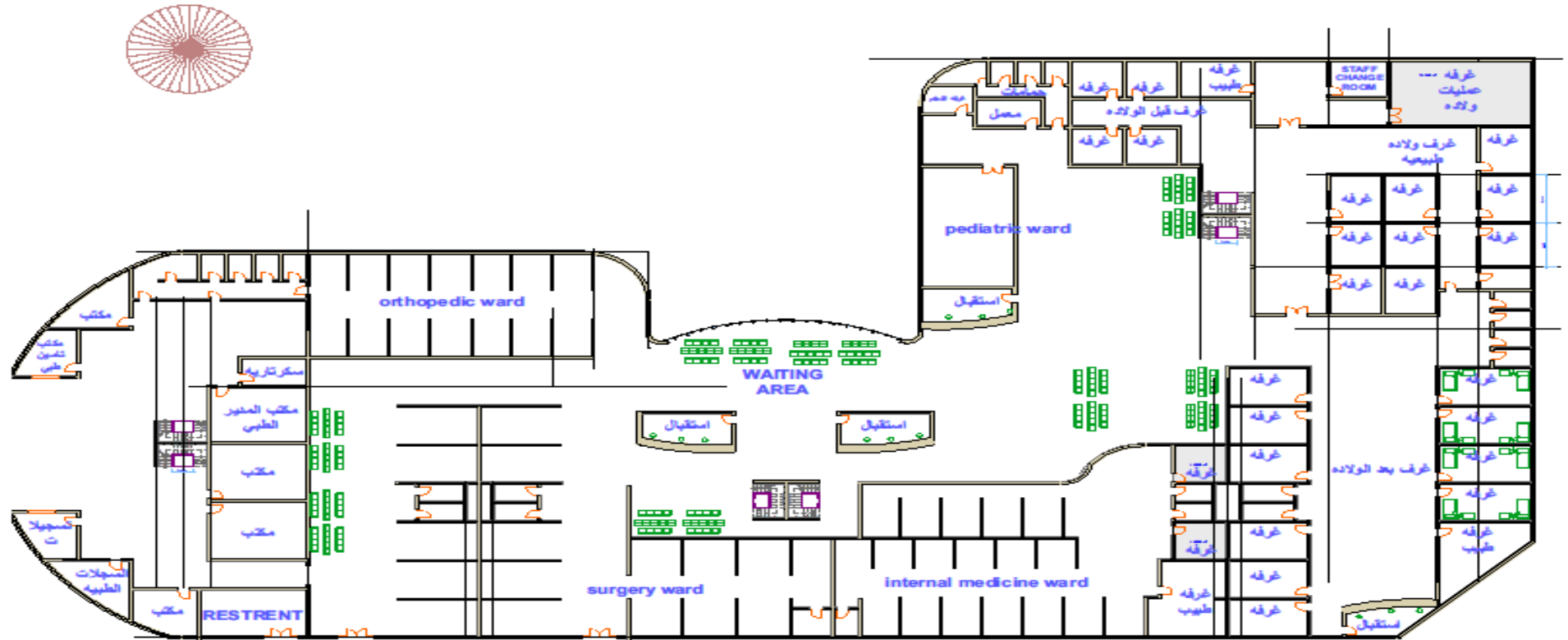


figure (5.13):Second floor ARCHICAD design

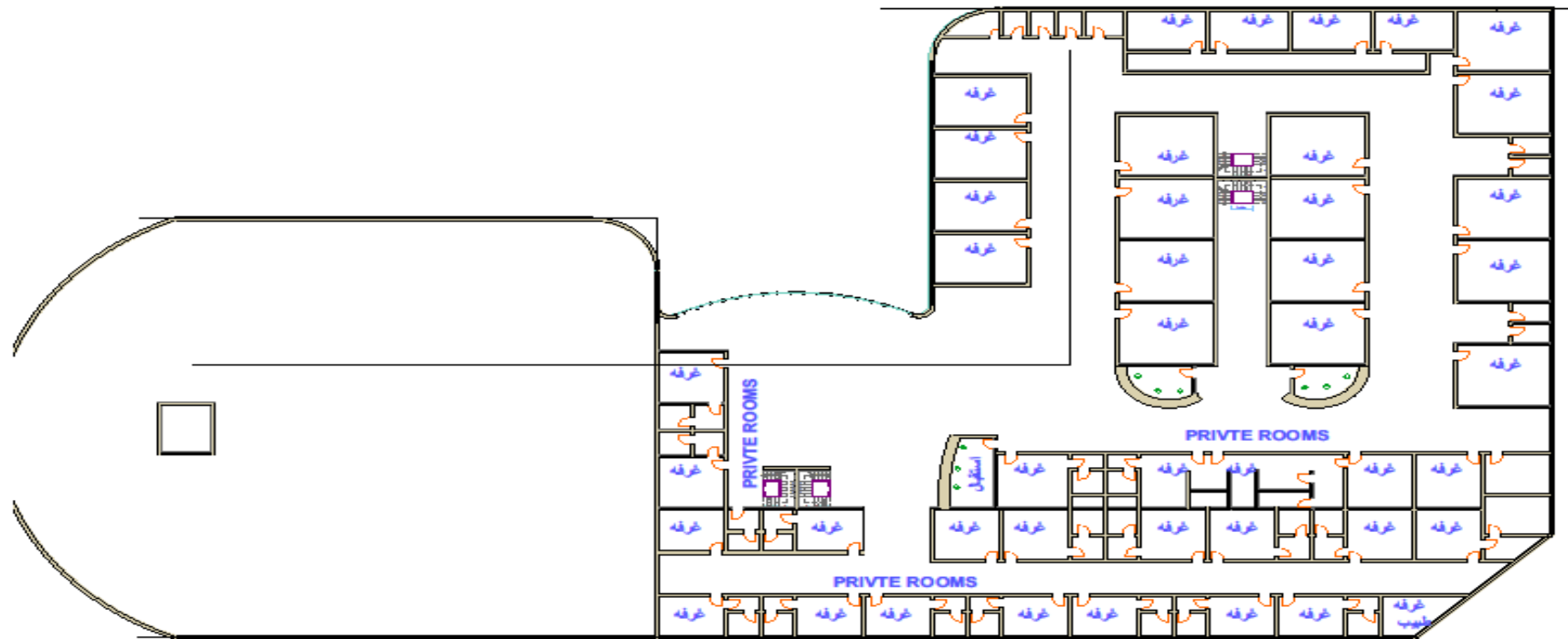


Figure (5.14) : Hospital third floor ARCHICAD Design

5.5 3D Design:



Figure (5.15): shows the anterior view of the hospital



Figure (5.16): lateral view of the hospital



Figure (5.17): shows The main entrance of the hospital



Figure (5.18):shows parking and pray area



Figure (5.19): shows ambulance entrance and pharmacy

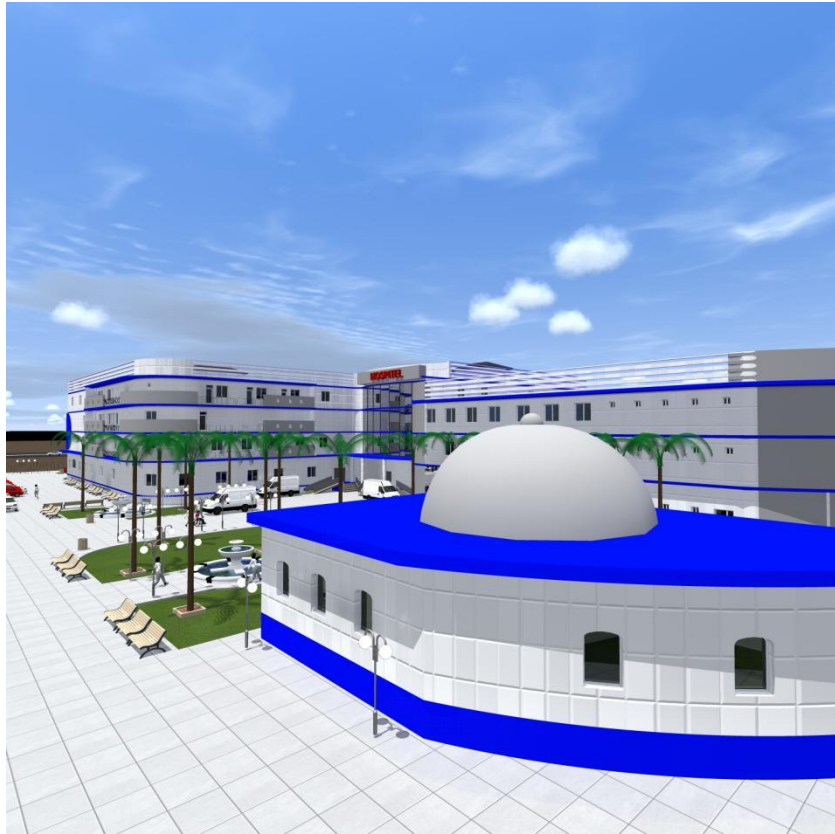


Figure (5.20): lateral view showing the mosque

5.6 The Interior Design

5.6.1 X-ray room



Figure (5.21): X ray room with control room

5.6.2 CT scan room



Figure (5.22) :CT scan room with the control room

5.6.3 laboratory :



Figure (5.23): side from the laboratory

5.6.4 examination room :



Figure (5.24) :emergency examination room

5.6.5 emergency room:



Figure (5.25) : Emergency trauma room

5.6.6 operation room



Figure (5.26): The main operation room

5.6.7 Intensive Care Unit



Figure (5.27) : Intensive Care Unit

5.6.8 Word:



Figure (5.28): The ward

5.6.9 Private Room :



Figure (5.29): One bed private room

5.7 Equipment planning:

Every hospital project requires different quantities and capacities of medical equipment based on the number of departments ,beds and the workload volume of the hospital in general

5.7.1 Equipment list

Standard equipment that is found in most emergency rooms are those that determine the vital signs. Emergency Departments are stocked with a huge array of intricate and oddly shaped, beeping and blinking equipment. It all serves an important purpose.such as:

- Portable Cardiac Monitors
- Vital signs monitor
- Cardiac Monitors With Facilities For Arterial Line, Pulmonary Catheter , Cardiac Output And Eeg Monitoring.
- Pulse Oxymeter
- Portable Defibrillators For The Ambulances
- Standard Defibrillators
- Transport Ventilators
- Ventilators
- Portable X-ray Machines
- Doppler Ultra Sound
- Echo cardiogram Machines
- Ultrasound
- Stethoscope
- Suture Tray
- Orthopaedic Equipment

Operation rooms (ORs) are specialized workspaces that require highly functional equipment of highest quality ,which surgeon and other OR personnel use to perform lifesaving procedures.those equipments are :

- Operating theatre light (5 spotlights)
- Operating Table (Trauma/Multifunction, electric/hydraulic driven)
- Anesthesia trolley (anesthesia machine with ventilator and monitor)
- Electrosurgical Unit (Monopolar-bipolar)
- Operating instrument set

The Radiology department has three imaging equipment include X Ray

- X-Ray Film processor tabletop
- X-ray Film Viewer
- X-Ray Unit
- MRI machine
- CT scan machine

ICU and CCU:

- Electrocardiograph
- Syringe pump
- Infusion pump
- Suction Pump
- Defibrillator
- Ventilator ICU
- Laryngoscope
- Mobile X-Ray
- Ultrasound

Laundry contains washing and drying machine and ironing machine .

Central sterile services department (CSSD) should has ultrasonic cleaner ,washer disinfectant ,packing tables and steam sterilizer .

5.8 Hospital system :

Because the importance of the emergency medicine the system must include efforts to heighten awareness,promote injury or trauma as a health problem responsive to effective countermeasures,and instruct the public about how the system operate .

5.8.1Components of the hospital system:

Human resources:

Because the system cannot function without qualified personnel at points within the system where they are essential, a needs assessment is the basis for addressing human resources requirements within the system. A quality system provides quality education to its providers, this includes all personnel along the emergency and trauma care continuum: physicians, nurses, emergency medical technicians (EMTs), and others who impact the patient's family.[12]

Pre-hospital care : emergency and trauma prior to hospital arrival often sets the stage for subsequent resuscitation and definitive care. It has a direct effect on survival. The system must ensure prompt access and dispatch of qualified personnel, appropriate care at the scene, and safe and rapid transport of the patient to the hospital.[12]

Communication : A reliable communications system is essential for providing optimal trauma care. It provides essential coordination among the components of the emergency system. It must include universal access through enhanced technology, trained dispatch personnel who can dependably match EMS personnel at the trauma incident to communicate with dispatch, with the hospital and with other units.[12]

Medical director: Medical direction provides the operational matrix for care provided in the field. It grants freedom of action and limitations to EMTs who must rescue injured patients. The key authority is the medical director, who is responsible for the design and implementation of field treatment guidelines, their timely revision, and their quality control.[12]

Triage : triage means sorting of patients but actually refers to the matching of the patient's needs with the resources within the system, if the patient is taken to the trauma center but has minimal injuries, the patient is overtriaged. This increases costs and has the potential to overwhelm the hospital most needed for the critically injured.[12]

5.8.2 Staff planning:

Emergency hospital should hire staff who are specialised and qualified and well trained to deal with the emergency and sudden cases.

Also the adequate number of staff very important at the hospital .

Triage system is essential and important in the emergency hospital and should have medical staff to evaluate the case and to put the patients in order to be treated .

Medical staff in triage consists of physicians ,nurses ,emergency technician.

5.9 Cost Estimation:

5.9.1 Construction cost

The cost for construction for all floors is 15,000,000 USD

5.9.2 Equipment cost

The estimated cost for the medical equipment and other equipment are shown in table (5.1)below

Table (5.1) : the estimation cost for hospital equipment

Item	Type	Cost(USD)
1	Medical equipment	1,800,000
2	Radiology	1,100,000
3	Physiotherapy	200,000
4	Furniture	100,000

From the above estimations the total cost for the hospital is 18,200,000 USD.

Chapter six
Discussion, Conclusion and
Recommendations

Chapter six: Discussion, Conclusion and Recommendations

6.1 Discussion:

Trauma and Emergency services is a vital and essential because injury is always unexpected and unplanned and if not treated urgently can result in damage, deformity and death. The patients entering an emergency department can be saved only if they arrive at the right time, at the right place, receives the right treatment and right resources. The aspect of speed, accuracy and sympathy are important in the emergency hospital.

Because of the importance of the emergency hospitals, the study went in for designing a hospital for emergency and trauma with high standards.

Visits and interviews were held to hospitals and healthcare facilities to see what problems need to be solved. Most of the interviewees agreed with the idea of establishing a separated emergency and trauma hospital.

In these visits found that most hospital suffering from the shortage of beds in the emergency departments, and lacking of staff.

The only emergency hospital in Sudan is near the military hospital

6.2 conclusions

This study support the need to establish a separated healthcare facility to receive only the emergency and trauma cases. interviews were held and questionnaires are filled from medical staff and visits to the emergency departments are also done. depend on the services and population in the country the location was selected and area was calculated with equations.

The location selected depend on the lack of hospital in the area, the nearest hospital located 22 kilo meters from our location.

The building consists of three floors which designed using the simulation program (ARCHICAD).

6.3 Recommendations

To improve the emergency services in this country the study recommends the following :

1. Pay attention to the emergency service facilities design to improve the healthcare services.
2. Emergency medicine certificate should be essential for the emergency staff .
3. Pay attention to give training to the biomedical engineer on how to use the design simulation programs(AUTOCAD ,ARCHICAD)

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(2)<http://www.hfmmagazine.com/articles/727-are-freestanding-emergency-departments-a-cure-for-crowding> [Jan 16, 2017]

Appendix A

Basic information

1. Is your hospital
 - a.Public
 - b. Private
 - c.Military

2. Approximately how many beds does the hospital have -----
 - a. 50 - 100
 - b. 150 - 200
 - c. 250. - 300

3. Approximately how many beds does the emergency department have?
 - a. 5 - 10
 - b. 20 -30
 - c. 40 - 50

4. Does the emergency department open 24/7?
 - a. Yes
 - b. No

5. Can any person treated in your emergency department
 - a. Yes
 - b. No

6. How do most patients access the emergency department
 - a.Ambulance
 - b. Private transport
 - c.Others

7. Does the emergency department have its own ambulance
 - c. Yes
 - d. No

8. How many physicians are on the emergency department ?

- a) 2-5 b) 7-10

9. How many physicians work at the busiest hours ?

- a) 3-5 b) 6-10 c) 11-15

10. Approximately what percentage of physicians at your Emergency Department are specialized in emergency medicine?

- a) 30% b) 50% c) 70% d) 100%

Emergencies

11. Does the emergency department have a system for triage priority screen?

a. Yes

b. No

12. Is the emergency department equipped to handle multiple trauma victim (3 or more) simultaneous

a. Yes

b. No

13. Do you treat following emergency

- | | | | | | | |
|--------------------------|-----|--------------------------|----|--------------------------|------------|--------------------------|
| a. Cardiac emergency | yes | <input type="checkbox"/> | no | <input type="checkbox"/> | some times | <input type="checkbox"/> |
| b. Obstetric emergency | yes | <input type="checkbox"/> | no | <input type="checkbox"/> | some times | <input type="checkbox"/> |
| c. Ophthalmic emergency | yes | <input type="checkbox"/> | no | <input type="checkbox"/> | some times | <input type="checkbox"/> |
| d. Orthopaedic emergency | yes | <input type="checkbox"/> | no | <input type="checkbox"/> | sometimes | <input type="checkbox"/> |
| e. Burns emergency | yes | <input type="checkbox"/> | no | <input type="checkbox"/> | sometimes | <input type="checkbox"/> |
| f. Paediatric emergency | yes | <input type="checkbox"/> | no | <input type="checkbox"/> | some times | <input type="checkbox"/> |

Equipment

14. Does the emergency department have the following equipment

- | | | | | |
|-----------------------------|-----|--------------------------|----|--------------------------|
| a. Electrocardiogram | yes | <input type="checkbox"/> | no | <input type="checkbox"/> |
| b. Code/cart /defibrillator | yes | <input type="checkbox"/> | no | <input type="checkbox"/> |
| c. Oxygen | yes | <input type="checkbox"/> | no | <input type="checkbox"/> |
| d. Pulse oximeter | yes | <input type="checkbox"/> | no | <input type="checkbox"/> |
| e. X-ray | yes | <input type="checkbox"/> | no | <input type="checkbox"/> |
| f. Ultrasound | yes | <input type="checkbox"/> | no | <input type="checkbox"/> |
| g. CT scan | yes | <input type="checkbox"/> | no | <input type="checkbox"/> |

Medication

15. Does the emergency department have medications for

- a. Poisoning
- b. Heart condition
- c. Seizures
- d. Inflammation
- e. Respiratory distress
- f. Burn/ skin irritation
- g. Sedation

Ancillary services

16. Which ancillary services are available in the emergency department

- a. Lab
- b. Radiology
- c. Anaesthesia
- d. Respiratory therapy
- e. Electrocardiography

Personal input and opinion

17. What thing you wish the emergency department had that make your job easier/

18. What thing do you wish the emergency department had that would improve patient outcome

19. What development would you like to see in the emergency department in the future ?

20. Do you agree with idea of out-stand accident and emergency hospital and why

a. Yes why -----

b. No why -----

20. Where do yo suggest the best location for the hospital?

Appendix B

Equation

Total land area per bed (except parking) = $1.4 \times 170 \text{ m}^2 / \text{No of floor}$

Where

170= total built area per one bed

1.4 =Total allowances for external area (except parking)

Appendix c











