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Design of An information System for Medical Laboratories

تصميم نظام معلومات للمعامل الطبية

A Thesis Submitted in Partial Fulfillment of the Requirement of M.Sc. Degree in Biomedical Engineering

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الآيـــة

قَالَ تَعَالَىٰ:

﴿ وَقُلِ ٱعۡمَلُواْ فَسَيَرَى ٱللَّهُ عَمَلَكُمۡ وَرَسُولُهُۥ وَٱلۡمُؤۡمِنُونَۖ وَسَتُرَدُّونَ إِلَىٰ عَٰلِمِ ٱلۡغَيۡبِ وَٱلشَّهَٰدَةِ فَيُنَبِّئُكُم بِمَا كُنتُمۡ تَعۡمَلُونَ ١٠٥ ﴾

صدق الله العيظم

سورة التوبة الآية (١٠٥)

DEDICATION

I dedicated

To the candle of my life

(My Mother).

To my father, To my family , To my Friends

To my Teachers, To my colleagues

& To those who are searching knowledge.

ACKNOWLEDGEMENTS

I would like to thank my family members, and my friends for their support and help. Without their cooperation, it was impossible for me to achieve this goal in my life.

Finally , I would like to express my deep sense of gratitude and respect to my supervisor, **Dr. Mohammed Yagoub**, in department of Biomedical Engineering for his excellent guidance.

Content:

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Abbreviation:	
ACARS	An Acronomy for Communication Addressing and Reporting System.
API	Application Programming Interface.
ARCNET	Attached Resource Computer NET work.
ASP.NET	Active Server Pages.NET.
BBLIS	Blood Bank Laboratory Information System.
BUN	Blood Urea Nitrate.
BB	Bulletin Board.
BC	Birth Control or Birth Certificate
CIS	Clinical Information System
CMR	Clinical Medical Record
CPOE	Computerized Physician Order Entry
CLIS	Clinical Laboratory information System
DBMS	Data Base Management System
e-Health	Electronic Health.
EMR	Electronic Medical Record
ER	Emergency Room
ESR	Erythrocyte Sedimentation Rate.
Hgb	Haemoglobin
HER	Health Electronic Record
HCT	Health Control Technology
HTML	Hyper Text Markup Language
ICU	Intensive Care Unit
ICT	Integrate Circuit Technology
LAB	Local Area Network
LAN	Laboratory
MPI	Master Patient Index n
MCV	Main Cell Volume
MCH	Main Cell Hemoglobin
MCHC	Main Cell Hemoglobin Count
MRN	Medical Record Number
MVC	Model View Controller
PACS	Personal Access Communication System
POCHER	Personal Controlled Electronic Health Record
QC	Quality Control
Rbcs Count	Red Blood Cells Count

Retics	Ricutocyte
SQL TDF	Structure Query Language Terminal Digit Filing
USA	United State of America
VV	Vice Versa
WANs	Wide Area Networks
WBC	White Blood Cells
XML	eXtensible Markup Language

ABSTRACT

The use of a computerized system is becoming more important in medical laboratories around the world .A good designed and installed of laboratory information system brings accuracy and accessibility to the flow of samples and data in the clinical laboratory.

An information system for medical laboratory will be able to handle all the basic information management needs and has the capacity to quickly and easily to manage, analyze and retrieve data. That means it possible to access data by patient's name, by laboratory department or patient's number or by test result and analysis performed. This kind of data searching is almost impossible with paper-based system. The system offers some benefits over paper – based systems like error reduction ,quality control management and needs small space to store records compared between medical record written on papers which may be damage or loss.

An information system for medical laboratory has been aimed to reduce and eliminate existing paper based approaches and to minimize human's errors, repetition or duplication of records and reduced cost of operation time. An information system for medical laboratory designed to mange patient record by sending data from the reception to doctor office to laboratory department(Hematology , Chemistry and Parasitolgy) and database office and saved all the patient's medical information by using suitable programmable language (C# and SQL) which is modern ,type safe programming language ,object oriented language that enables programmers to quickly and easily build solution for Microsoft.

This trial version was reviewed for some specialists in medical laboratories and the results were satisfactory

المستخلص

أصبح إستخدام ألانظمة المحوسبة أكثر أهمية في المختبرات الطبية حول العالم. فلابد من تصميم وتركيب نظام معلومات لإدارة معلومات المختبرات الطبية يتميز بالدقة وسهولة الوصول الى تدفق العينات والبيانات في المختبر الطبي . بحيث يكون نظام المعلومات قادرآ على التعامل مع جميع إحتياجات إدارة المعلومات الاساسية ولديه القدرة على إدارة البيانات وتحليلها وإسترجاعها بسرعة وبشكل جوهري.هذا يعني أنه من الممكن الوصول الى البيانات عن طريق البحث بإسم المريض أو رقم المريض أو عن طريق نتيجة الإختبار والتحليل الذي تم إجراؤه أو عن طريق قسم المختبرالمختص بالفحص.وذلك مقارنة مع النظام المستند الى الورق حيث أنه يكاد يكون مستحيلا.

تتميز الانظمة المحوسبة على الانظمة القائمة على الورق ببعض الفوائد مثل الحد من الأخطاء و إدارة مراقبة الجودة وتحتاج الى مساحة صغيرة لتخزين السجلات مقارنة بين السجلات الطبية المدونة على الورق والتي قد تكون عرضة للتلف والضياع اذا لم تحفظ بصورة جيدة.وأيضا يهدف نظام المعلومات الخاص بالمختبرات الطبية الى تقليل وإزالة الاساليب القائمة على الورق وتقليل الأخطاءالبشرية وتكرارها أو إزدواج السجلات وإدارة تكلفة ووقت التشغيل.

[1]صمم نظام معلومات المختبر الطبي لإدارة سجل المريض عن طريق إرسال البيانات من مكتب الإستقبال الى مكتب المريض الى قسم المعمل المتخصص (أمراض الدم،الكيمياءوالطفيليات) ثم ترسل نتائج فحوصات المريض الى مكتب قاعدة البيانات لحفظها وطباعتها. وتم ذلك عبر لغة برمجة مناسبة (SQL &C#)،وهي لغة برمجة حديثة تمكن المبرمجين من بناء نوافذ مع وجود حلول سريعة وجوهرية ل Microsoft. تمت معاينات هذه النسخة التجريبية لبعض المختصين في المعامل الطبية و كانت النتائج مرضية.

Chapter One

Chapter One

Introduction

1.1 Generalization:

Medical/health records is a written collection of information about a patient's health and treatment, they used essentially for the present and continuing care of the patient. Medical records used to management and planning of health care facilities and service [1].

Doctors, nurses and other health care professionals wrote up medical/health records so that previous medical information was available when the patient returned to the health care facility and the medical/health record should be available. If a medical record couldn't be Located, the patient suffered because information, which could be vital for their continuing care, was not available. If the medical/health record couldn't be produced when needed for patient care, the medical record system was not working properly and confidence in the overall work of the medical/ health record service was affected [2].

Figure (1.1):Manual record form and place of storage .

The figure(1.1) show the manual patient record wrote by nurses and small storage place to save the papers.

Manual medical record systems were replaced by computerized medical information systems (CMIS). In EMIS, facts concerning the

health or health care of individual patients stored and processed in computers. Computerized laboratory information system defined as an information system that linked basic hospital offices such as registration, admission, laboratory department (chemistry ,hematology and parasitology) and results office . The medical record staff made sure that the information collected on each patient stored in the medical record, It should be also available when and where needed for the continuing care of that patient. Health Information Systems designed to integrate data collection, processing, reporting, and the used of information necessary for improving the effectiveness and efficiency of the health service through better management at all levels of health care .Health records were important for judicial reviews of the health staff and the development of the disease [3].

1.2 Problem Statement:

Recording patient data in the paper needed a lot of time for documentation and place with suitable condition to storage . If a medical record couldn't be located and information was not available (damaged of record or lost) , the patient may suffer. .

1.3 Objectives:

Here we will introduce the general and specific objectives of the project

1.3.1 General objectives:

To design a computerize laboratory information system (CLIS) to save patient data, save doctor time schedule, improve hospitals management and budget.

1.3.2 Specific objectives:

- To manage Lab data from sample log-in to reporting.
- To sort and organize data into various report formats.

- To store data for future reference and use.

1.4 Methodology:

Computerized Laboratory Information System is a computer-based software application used in the laboratory to manage and analyze samples, test results, laboratory staff, laboratory equipment and aims to produce reports and other functions. It designed to capture and store lab data sheets information electronically, the data sheets used as input documents for entry of results data into the systems integrated with the other stored computer data.

1.5 Thesis Outline:

1- This thesis included five chapters. Chapter two is literature review discussing previously used method , Chapter three Methodology it explain all the software used to implement the project , Chapter four Results and Explanation, the output discussed in this chapter and finally Chapter five will be conclusion ,it will conclude the whole project and recommendation for the improvement of the project.

Chapter Two

Chapter Two

Theoretical Fundamentals

In this chapter discuss the history of health record in past and today **.**

Essentially, an Electronic Medical Record (EMR) is defined as an electronic record of health-related information on a person that can be created, obtained, managed and operated by authorized health providers. The concept of EMR has evolved since the early 1970s. In the early 1970s, the EMR was a basis for investigation so as to improve medical health care [1]. The aim was to store medical data and other records for patients for long periods of time and at the same time ease the accessibility of such information.

2.1 Health Data in the Past:

The beginnings of health records date back to 3000 BC when the Egyptians started keeping the oldest form of health records. In ancient Greece, doctors recorded symptoms and treatments. In the 14th and 15th century, doctor's records developed and included advice on nutrition and effective methods of treatment of the disease and also notes on autopsies. The expansion of science increased the value of accurate health records, which in the 16th century became books of cases—casebooks, following the example of the legal profession. Since 1750, doctors kept health records in hospitals as a record of systematic and objective health practice. Health records in the late 19th century enabled doctors to analyze health data of individuals. The need for systematic data collection required hospitals to keep health records, although operators did not have standards prescribing which patient information should be collected. Certain doctors kept data in their own way, rendering the verifiability and comparability of results more difficult. The early 20th century saw an expansion of education in hospitals, which increased the need for standardized health records. Like education in health care, research was also gaining momentum and health records were often their main element [2].

2.2 Health Records Today:

Health information technology has developed around the globe. Different countries embrace different types of EMR systems. The manner in which the system is used varies from one country to another. There are numerous differences and similarities in the healthcare system of Saudi Arabia compared to other countries in the world. In the U.S., the HITECH Act, signed in 2009, gave healthcare providers incentives to implement EMR technology. The adoption of the technology in the U.S. was mainly aimed towards improving the quality of health services. Furthermore, the U.S. government, through the Patient Protection and Affordable Care Act, has increased health insurance to millions of uninsured Americans [2]. Despite issues such optimization, implementation, cyber security and interoperability that have thwarted the implementation of EMR technology, there has been a strong push in the U.S. for its implementation. Implementation in the U.S. has been given a higher priority as compared to Saudi Arabia. Its average adoption rate as at July 2013 was at 69%.

The United Kingdom has also been in the forefront championing for the adoption of the technology. For instance, in 2002 the National Program for IT wanted to create a national electronic health record system to be used in the entire UK.

Nowadays health records are kept from birth to death of a person and the history of disease also contained .The records of the health status of individuals affect the good name and dignity of the individual and indirectly, the dignity and reputation of their descendants and close relatives. Health records consisted of various data entered by health care professionals in either paper or electronic form, with digital images, photos, digital images of the fetus, computerized tests and letters or other health information. Health records handled and stored by health care administrators and nurses[3].

Chapter Three

Chapter Three

Back ground studies

EMR has been implemented in many different hospitals and clinics around the world. The implementation of this system was to improve the quality of patient care and reduce medical errors. Moreover, EMR provides facilities that not only improve the safety of the patient but also enhances workflow in healthcare facilities [1].

This chapter focused on the different programming language and method used to design medical record systems .

3.1 Terminal Digit Filing:

Terminal digit filing is a simple and accurate filing method that made it easier for clerks to file. They may also file faster and sometimes more accurately. The method of filing designed for large acute care facilities and not appropriate for medical record systems in small developing countries where the volume of medical records to be filed was low. TDF used to spread medical records evenly throughout the filing room. It used in facilities where the volume of medical records was large and enabled the distribution of work between a number of clerical staff. This method was not recommended in countries where the number of records is small and It also not recommended when clerks not trained in its implementation and use. Incorrect implementation caused problems and confidence in the staff of the Medical Record Department affected and the files needed filing room to storage [4,5].

3.2 Master Patient Index:

Master patient index was the first procedure to be computerized. The information in a computerized MPI was the same as that recorded in a manual. The objective of a computerized MPI is patient identification. The main function is the entry, storage and retrieval of the patient's name and MRN. The system required a group of programmers that accessed by users via computer terminals and/or printing terminals. The programmers designed to enable access to the information held on the MPI file, and to build or modify the file information, as required by the hospital. The MPI holds information on all patients who attended or had admitted to a hospital. Clinical details are NOT held on this file, only basic information required to IDENTIFY the patient [6].

3.2.1 Implementation of a computerized MPI:

Computerization of the MPI spread over a period of time through entry of information already held on index cards from the manual MPI card system including all patients in hospital at the time of implementation; inpatient registration and outpatient registration. The entry of data on new patients completed at the time admitted as inpatients or registered as outpatients, that is, in the Admission office for inpatients and the outpatient department registration desk for outpatients. In a computerized MPI, the search programmers enabled the operator to locate a particular patient to determine if that patient had been in hospital previously and had a medical record number. Limited information on a number of patients (one patient per line) may be displayed on a screen for review or further action. When the particular person was identified, the full index file information for that selected patient displayed on the screen. If there changed to a patient's identification details, they made at the time of admission..

Strict security codes used to prevent unauthorized access and alterations when retrieved the information . Each user should had his/her own user name as well as a password, which assigned by the computer manager and changed periodically and changed regularly to prevent unauthorized access. Only an authorized user should be able to access information relating to a patient and to change, add to or delete records on the master patient index . MPI Card contained only necessery information for the patient so health card also a part of health records because it contained relevant health information[6].

3.3 Development Languages for LIS:

One of the most important aspects to consider when developing a CLIS is the database technology to be used. Most of LIS support relational SQL (Structured Query Language) databases such as Oracle ,access,…

3.3.1 Implementation of LIS using Java programming language:

Selecting the right language to implement the LIS is a difficult process. Many aspects could be considered; functionality, readability, portability, maintainability, support, tools, etc . Java is one of the most flexible and widespread programming languages available, provided platform independent software development, Java enjoyed a plethora of support, including distributed computing, networking, and enterprise technology. Standard and non-standard APIs and other support tools emerged all the time, making Java an extremely strong contender. But Java had many disadvantages like ;Performance means java is comparatively slower and took more memory space than the other programming languages, Single Paradigm means in actually predominantly as single paradigm language and enumeration types stimulated by using a serial constant instead of them.[7]

3.3.2 Implementation of LIS using XML programming language :

XML (eXtensible Markup Language) provided a flexible way of creating a common data format to facilitate for the sharing and distribution of information on-line. XML provided a means for obtaining and supplying information about things in a standard way. XML presented information in line with the user's requirements, rather than a standard HTML page. Compared to traditional closely coupled interface methods, XML-based systems could be loosely coupled, which are more maintainable and less expensive. XML used peer-to-peer message passing ,the peer-to-peer architecture helped to keep the network protocol as generic as possible–systems learned where neighbors were , rather than having an explicit hierarchical structure. Secondly, a peer-to-peer messaging system survived if one machine fails. Each system will simply re-route the packages through a different route. The appeal of the XML interface is its ease of development, maintainability and potential for reuse. The XML interface aided a LIMS in situations such as job and sample submission, LIMS data archiving and the integration of two LIMS in different labs. The EHR systems facilitate patient safety and quality development through; use of checklists, alerts, and predictive tools embedded clinical guidelines that promote standardized, evidence-based practices electronic prescribing and test-ordering that reduces errors and redundancy and discrete data fields that foster use of performance dashboards and compliance reports. The proposed system will be developed using ASP.NET as a technology of web based system. In this paper; most of the services, enjoyed on the internet are provided by web database applications and using .net technology. Such as, Web-based email, online shopping, forums and bulletin boards, corporate web sites, and sports and news portals are all database-driven [8].

3.4 Implementation of LMIS using of LARAVEL FRAMEWORK:

The Laboratory Information Management System was made by using laravel framework.. Laravel is PHP framework with MVC design (Model-View-Controller) which is used to create website application. Model View-Controller (MVC) is a concept for encapsulating data along with processing (model), isolating from the process of manipulation (controller) and view to be represented on a user interface . The functions of management information system of laboratory included the management of activities, information, and integration of devices and processing of other computer systems in .There were 3 stages to implement the system , data collection, design, and build stage. The first stage to make the system was the data collection stage by conducting literary studies and interviews. From the process of literary study and interviews, it was obtained workflow, list of the needs of the current situation, laboratory data from the department and the theory concerned with the development of the system. The case was shown in Figure. The next process was the design stage, the system design was done according to the needs analysis that had been done. The design process of this system input employed Use Case, Class and Entity Relationship. The next step was the building stage which was done by preparing tools and materials, then performing the coding by using laravel framework. After that, the system was tested in alpha testing to know whether the system has been as expected or not, if it was not appropriate, the coding would be performed again and again [9].

3.5 Implementation of LMIS using Internet-based language:

Security, Confidentifity and Reliability are fundamental in maintain data quality.

Internet-based learning is the traditional education language. It used to design electronic record ,interfaces by visual studio. Internet –based language was negative effect of network resources on learners' interest: Too much information on internet confused learners, therefore they gave up searching. Spending too much time searching frustrates learners' motivation and Internet-based learning was inferior to traditional ways of learning: During natural communication, learners can see each other , they used many ways to communicate such as facial expressions. During natural communication listener known the meaning of speaker and if he couldn't understand, he could judge by means of different ways, but Internet-based learning was powerless and it couldn't give detailed account of the learners' recognition ability [10,11,12].

3.6 Characteristics of CLIS:

The most important functional characteristics of CLIS product : input of data and results, enrollment of samples, tracking samples, report generation, simplicity of use and training, security of applications, reviewing of results and their verification (validation), customization of reports, flexibility and adaptability and conformity to normative documents. The laboratory information system should be an optimal, flexible, and multifunctional tool for management and for increasing the efficiency and quality of analytic studies in laboratories that operate in different areas of activity. The use of laboratory information systems provided analytic laboratories with confirmation of their capabilities [13].

3.7 Challenges of CLIS:

1. Power supply – Absence of constant supply of electricity poses a huge deterrent to the introduction of any computer-based solution.

2. Lack of requisite equipment – Quite often, regular power cuts hamper the use of automatic testing equipment and technicians should revert to less sophisticated and less precise testing methods.

3. Low internet penetration – In areas where constant power supply was present, internet availability was rare. Lack of connectedness among various laboratories gave the impression that involving an ICT solution would most probably be

unfeasible.

4. Computer proficiency – Laboratory staff had not prior experience using computers on a regular basis. In some of the user evaluations conducted of BLIS, participants had to be instructed on basic use of keyboard and mouse for interacting with the computer.

5. Equipment maintenance – Funding programs provided computers and/or automatic testing equipment to laboratories as aid ,the procurement of such items was highly non-standardized and maintenance policies were significantly overlooked. That results in equipment lied in the laboratories waiting for months to be repaired or upgraded.

6. Local expertise – Capacity-building programs for system engineering and similar skills are not present close to field locations, and if present, they didn't aware of projects being funded from outside the country. That poses a challenge to the sustainability of such projects.

7. Ad-hoc used of log books – Log book formats were non-standardized and prone to erroneous data entry. In the event of column widths not being enough for entire test results data, technicians had to improvise by using adjoining columns and/or using registers as auxiliary logbooks [13].

3.8 Benefits of effective LIS:

The effective CLIS solution which could address those challenges had benefits that could greatly improve quality of lab data for making informed clinical decisions:

1. Reduction of record-keeping burden – A software solution that maintains consistency and persistence of entered data went a long way in reducing the burden of record keeping on laboratory staff.

2.Fewer errors – Clerical errors at the pre-analytic and post-analytic stage form the bulk of errors in laboratories as shown in figure (3.4). An electronic LIS that

Performed precise validation of reference ranges and allowable values at the point of data entry reduced the number of such errors.

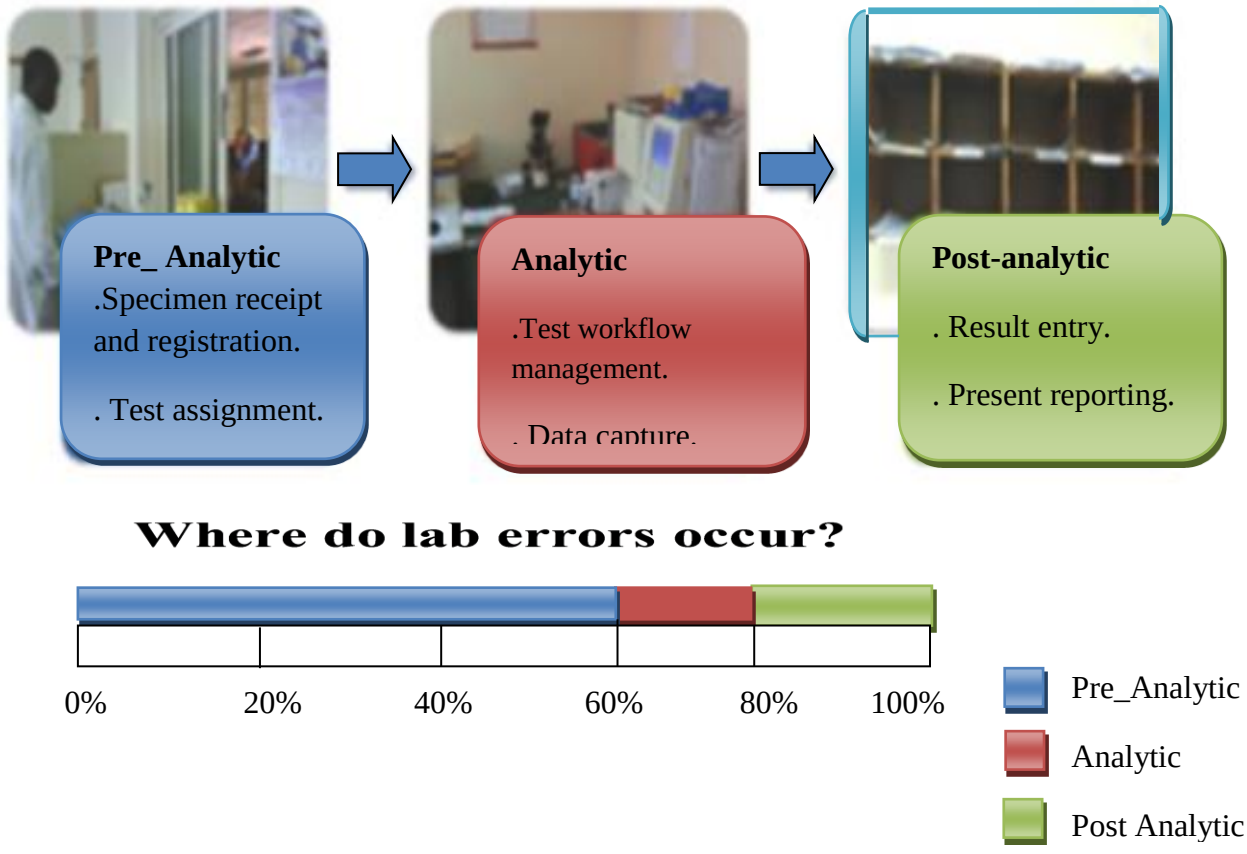


Figure (3.1):Shown The typical workflows in a clinical laboratory.

The figure(3.1) shown The typical workflows in a clinical laboratory and the percent of errors occurred in that stages ,the first stage ,Pre-analytical : Test requested by doctors ,the quality and integrity of test samples specimen collected by nurses , the second stage ,analytical stage : Specimen received and tests ordered by specimen processing service---Tests performed by technologists and all aspects of all testing and result review process ,Finally, Post-Analytical phase: The reporting of finalized results, interpretations and diagnosis. Results reviewed by doctors.

3.Reduced waiting time and more reliable results for patients – When bulk of data maintenance was done by the LIS, laboratory technicians could focus on their existing data records in the system.

4. Ease of reporting – Generating cumulative statistics was straightforward on an electronic LIS, whereas generating a simple count of tests done over a time period c took hours as logbook entries needed to be read sequentially for manual counting.

5.Ability to view aggregate trends – Once data was consistently being maintained in a laboratory information system, it opens up possibilities to perform various kinds of analysis on the corpus of test results and to infer trends and patterns.

6.Country-wide integration – We were at a stage where ICT solutions were being introduced throughout the developing world. At such an early stage, it imperative to build systems that in the longer term, integrate with other country wide systems that would eventually be used, for e.g. patient medical records system, national ID databases, etc. A LIS solution should ideally form an integral parmain tasked of performing and interpreting tests. This leads to lesser reduced times for patients and to more accurate test results.

7. Ability to trace patient and specimen history – The manner in which log books are ordered by date of entry, a simple lookup for a patient name or sample ID on log book can take minutes if the date of registration was not known. On the other hand, an electronic LIS enabled fast and precise lookup/retrieval of data [17].

Chapter Four

Chapter Four

Methodology

Medial laboratory were the first and important department in the hospital.

It divided into many department according to human diseases and causes. Medial laboratory were the first and important department in the hospital . It divided into many department according to human diseases and causes. The purpose of this thesis to design an information system for medical laboratory to manage test result choosing clinical chemistry department, clinical haematology department and parasitology department.

4.1 Procedure:

This chapter focused on discussion of the project flow chart and the method to implementation. An information system for medical laboratory included: Databases ,Interfaces, Physician order entry ,electronic communication systems , the network that links these systems and the clinical work station.

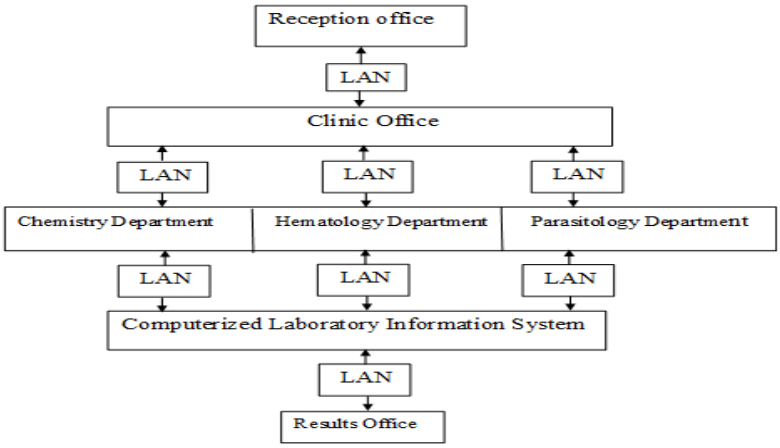


Figure (4.1):Block Diagram of data exchange from commmunication system

In the figure (4.1) data exchange from commmunication system carried information from reception between doctor office and laboratory department .

With establish networks (interconnected network systems), the patient's information and test results passed in real –time to affiliated hospital,reference laboratories and

outpatient clinic .

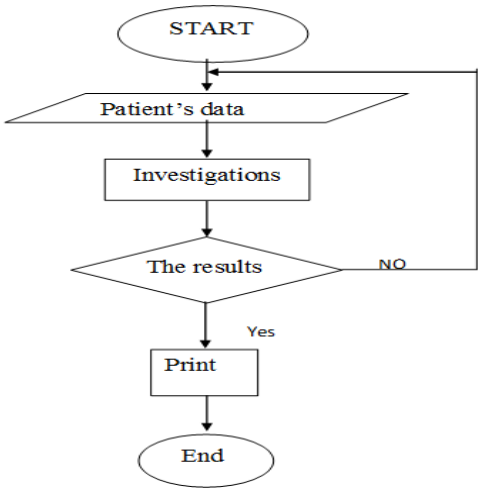


Figure (4.2): Flow chart of the ISML

In the figure (4.2),the flow chart showed the An information system for medical laboratory from the start to end , The information collected by medical record staff and the system printed a ticket contented a number , the data referred to doctor office and the patient met the doctor , then the doctors determined the investigating and laboratory department when patient did that investigations .The technical laboratory staff send the result to result office .Finally the system printed the result if the patient number is same to the ticket number otherwise the patient return to doctor

4.2 Software implementation:

The CLIS consisted of

4.2.1 Database:

A database is collection of information stored in a structured form or integrated records that organized so that it could easily be accessed , managed and updated . A shared collection of logically related data, could be used simultaneously by many departments and users [13].

4.2.2 Database Management Systems :

The DBMs is the software that interacts with users , application programs, and the database. The DBMs allowed users to insert , update, delete, and retrieve data from the database and enabled users to define ,create and maintain the database and also provided controlled access to this database [13].

4.2.3 C Sharp Language:

C# is an object-oriented programming language that has designed by Microsoft Corp, with syntax alike to Java. C# intended to be a simple, modern, general-purpose and OOP language. C# as modern programming language designed for implementing vast range of enterprise applications that implement on the .NET Framework. A development of C++ and C# is new, type safe and object-oriented. C# code is translated as managed code, this means it benefits from the services of the common language runtime. These services include language interoperability, garbage collection, high security, and evolved versioning support. Adopting C# in the meantime had the potential to increase capability, decreased programming difficulty, expensed lower maintenance costs, high integrity ,distributed system ,simplicity, usage, reliability ,concurrency , platform , maintainability and provided quicker time-to-market, new revenued streams and improved operational efficiency especially business [14].

4.2.4 Microsoft Query language Database Administrator :

Query language defined as the DBMs to provide a general inquiry facility to this data. The provision of a query language (such as SQL) alleviated the 0problems with earlier systems where the user had to work with a giving major software management problems. Also used as validation program that provides a reliable measure of technical proficiency and expertise in implementation and administration of Microsoft SQL databases [13].

4.2.5 Interfaces, physician order entry:

Data entry defined as the process of getting information into a database, usually done by people typing it in by way of data-entry forms designed to simplify the process. Used computerized systems must determine that individuals (e.g., employees, contractors) who develop, maintain, or use computerized systems had the education, training and experience necessary.

Training should be provided to individuals in the specific operations with regard to computerized systems that they are to perform. Training should be conducted by qualified individuals on a continuing basis, as needed, to ensure familiarity with the computerized system and with any changes to the system during the course of the study [2].

4.2.6 Interfaces by Visual Basic:

Is a third – generation event – derived programming language and integrated development environment (IDE) from Microsoft for it COM programming model first released in 1991. Visual Basic designed to be relatively easy to learn and use. Visual Basic was derived from BASIC and enables the rapid application development (RAD) of graphical user interface (GUI) application , access to data bases using Data Access Objects , or Remote

Data Objects or Active X Data Objects and Creation of Active X Controls and Objects. The scripting language VB Script is subset of Visual Basic.

4.2.7 Advantages of Visual Basic:

1.The structure of the Basic Programming Language was very simple , particularly as to the executable code.

2. VB was not only a language but primary an integrated , interactive development environment (“ IDE ”).

3.The VB – IDE had been highly optimized to support repaid application Interface of COM components called remotely via Distributed COM (“DCOM”), which makes it easy to construct distributed application.

4.COM component embedded in / linked to your application’s user interface an d also in / to stored documents (Object Linking and Embedding “OLE” , “Compound Documents”).

5.There is a wealth of readily available COM components for many different purposes.

6.Visual Basic built around the .NET environment used by all Microsoft Visual Languages. So there is very little that can’t be done in Visual Basic that can be done in other languages (such as C#) [15].

4.2.8 The Visual Studio.NET:

Microsoft Visual Studio . NET is an Integrated Development Environment (IDE), which is the successor of visual studio .It eased the development process of the .NET applications (VC# .Net, VB.Net.VC++.Net , and more) . debugger, project , solution explorer and class development [15].

4.2.9 The network that linked these system:

A telecommunications network is a collection of terminal nodes , links and any intermediate nodes which are connected so as enable telecommunication between the terminal.

The transmission linked connects the nodes together, the nodes used circuit switching, message switching or packet switching to pass the signal through BB . Each terminal in the network had a unique address so message or VV .the collection of address in the network called the address space [16].

4.2.10 Local Area Network:

A LAN is a network used for communicating among computer devices, usually within an office building or home. It enabled the sharing of resources such as files or hardware devices that may be needed by multiple users • It limited in size, typically spanning a few hundred meters, and no more than a mile, fast, with speeds from 10 Mbps to 10 Gbps , Required little wiring, typically a single cable connecting to each device and had lower cost compared to MAN's or WAN's. LAN's wired or wireless. Twisted pair, coax or fibre optic cable used in wired LAN's. Every LAN used a protocol –a set of rules that governs how packets were configured and transmitted. Nodes in a LAN linked together with a certain topology. These topologies include: – Bus – Ring – Star. LANs capabled of very high transmission rates (100s Mb/s to G b/s).

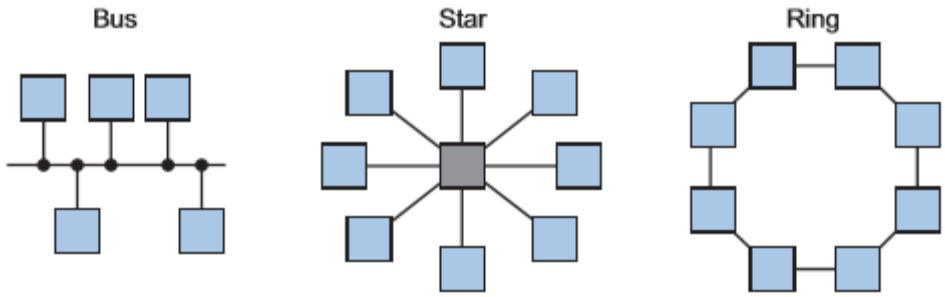


Figure (4.3): local area net work.

The figure(4.3) showed the topology of a local area network also called the geometry of the network, or how individual nodes connected to it. A network's topology greatly affects its throughput rate, implementation cost, and reliability [16].

Chapter Five

Chapter Five

Results and Explanation

In this chapter the output and the system forms options components discussed.

5.1 System Forms:

The medical record made up of a number of format, It used for a specific purpose. The main form had four options:

1- File included minimize and exit.
2- Windows included ,new registration ,new department ,medical check and laboratory department.
3- Tools included important phone ,Calculation, Admin tools (to control user and database).
4. Help included data about the system.

Figure (4.1): Computerized Laboratory Information System login

The figure(4.1)The form used for security purpose to specify the user. The form code depended on if the user password and password in the database as the same. Please open the system.

Figure (4.2): The main screen of CLIS.

The figure(4.2) the system built from five windows,the first window called reception form contained all the patient personal informatin,second windows called doctor window also contained all patient personl information sent from reception to doctor and the doctor determined the laboratoy department when patient did the investigation and sent the data to it,the thirt windows called laboratory window,It divided into three inner windows(Chemistry,Hematology,Parasitology) according to types of investigation the doctors sent data,the fourth windows called database window ,All the laboratory information system data collected here for purpose of reseaching and health management to improve the healthcare,Finally, the last window called result window,the result of all patient invesgation recored here and system printed the result the patient number and the ticket number were the same .

Figure (4.3): The reception screen of CLIS

The figure(4.3) the information collected by medical record staff recorded in reception form, personal patient data (patient name, age, sex, address, phone number and the date of recording) in this form we could add new patient ,new informing ,delete, or update the patient record . we should look at how a patient and his or her medical record identified. Accurate identification of a patient is the backbone of an effective and efficient medical record system. Correct identification needed to positively identify the patient and ensure that each patient had one medical record number and one medical record.

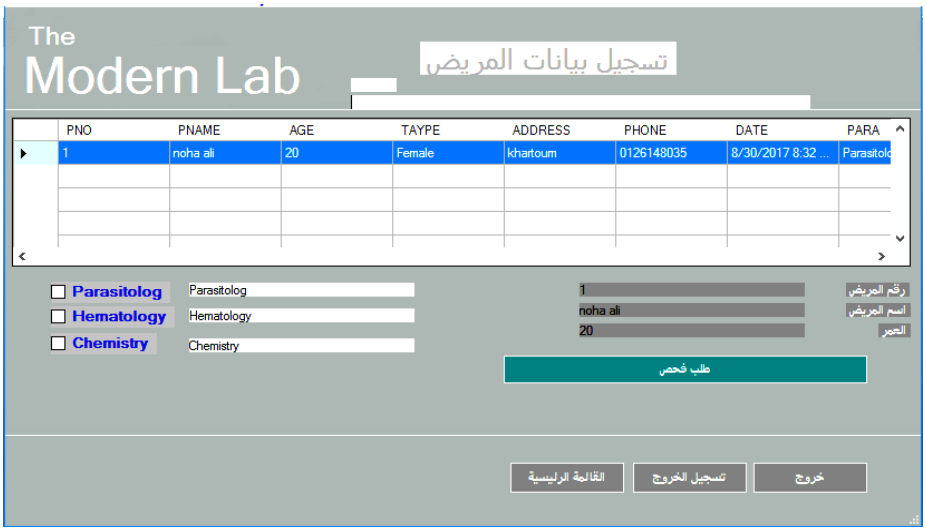


Figure (4.4): The doctor screen of CLIS.

The figure(4.4) the information collected by medical record staff recorded in reception form sent to doctor office via local area net work ,the doctor choose suitable investigation according to patient history and sent the data via LANs to laboratory department and the samples investigated here .

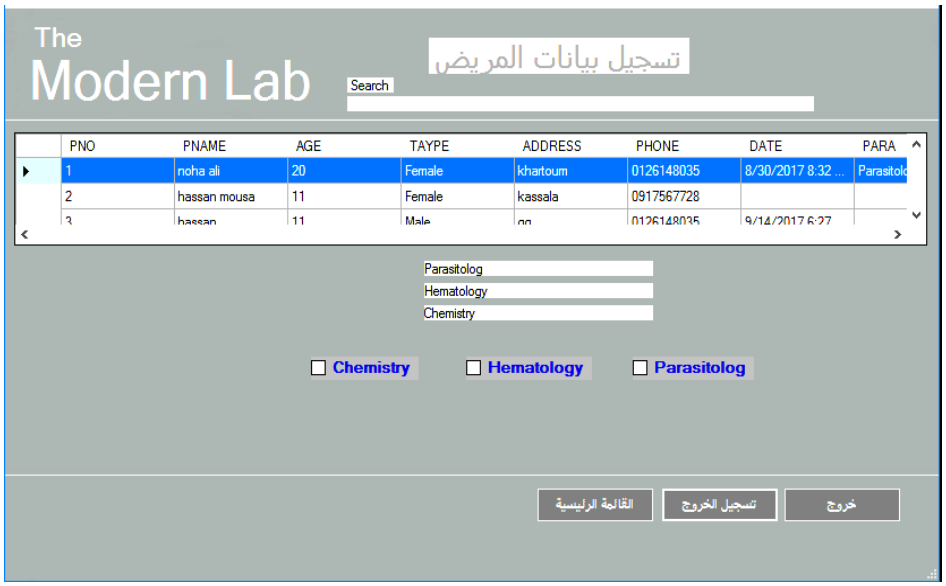


Figure (4.5): The laboratory screen CLIS.

The figure(4.5) all the patient information and laboratory department investigatins needed by doctor had appeared in this record.

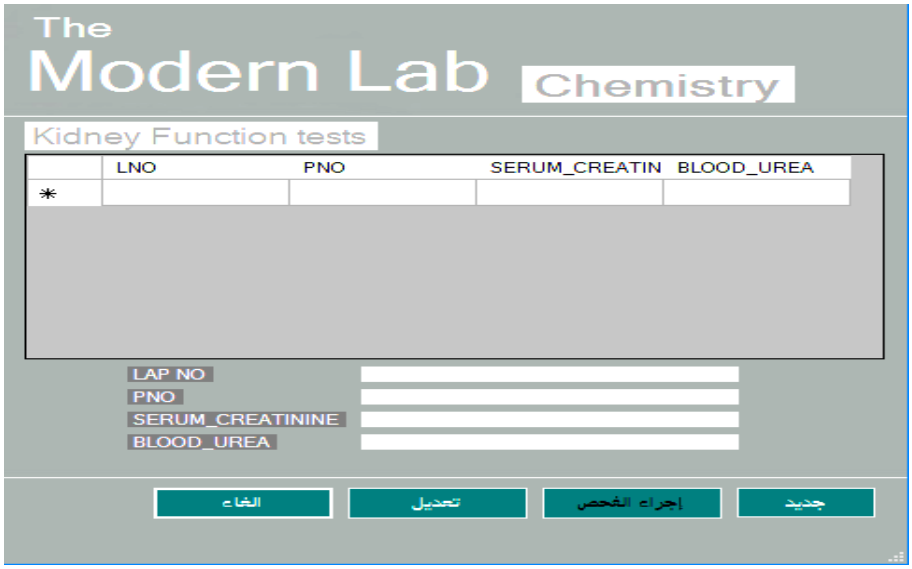


Figure (4.6): Chemistry form of CLIS.

The figure(4.6) chemistry laboratory tests recorded in this form for examples kidney function tests (serum_ creatinine and blood_ urea).

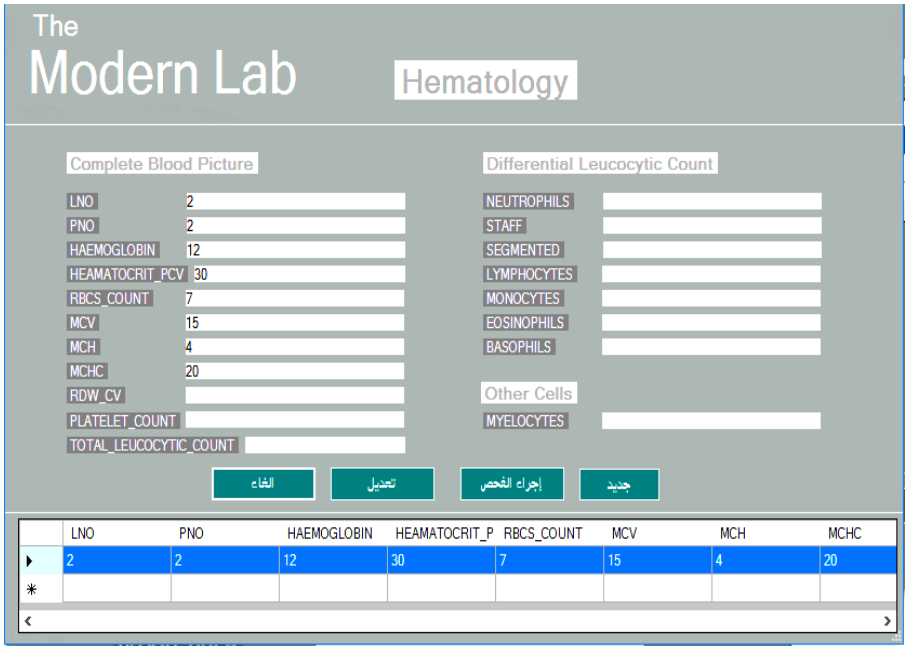


Figure (4.7): Hematology form of CLIS.

The figure(4.7) Hematology laboratory tests recorded in this form for examples complete blood picture (Hemoglobin ,MCH, MCV,,,,,) and Differential leucocytic Count then the results send to result's office.

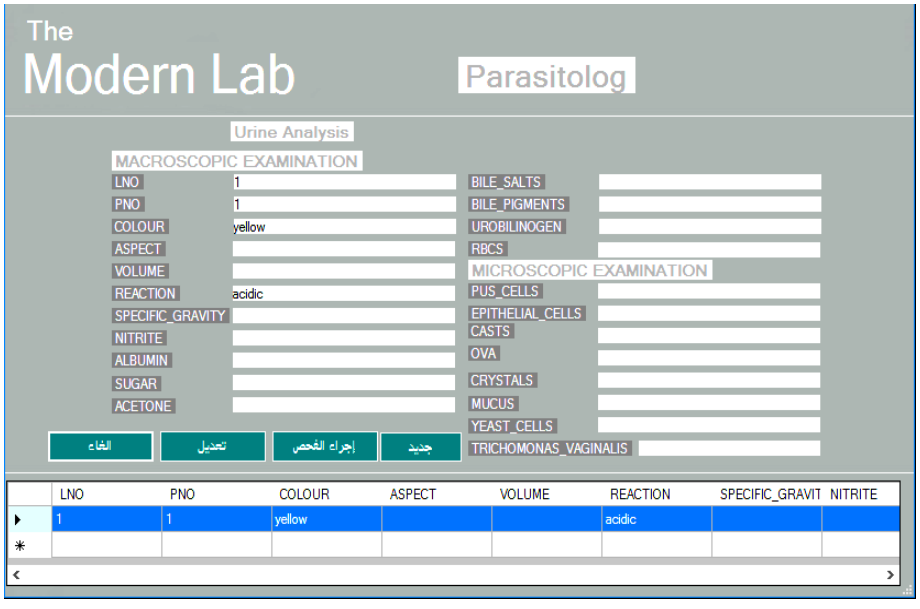
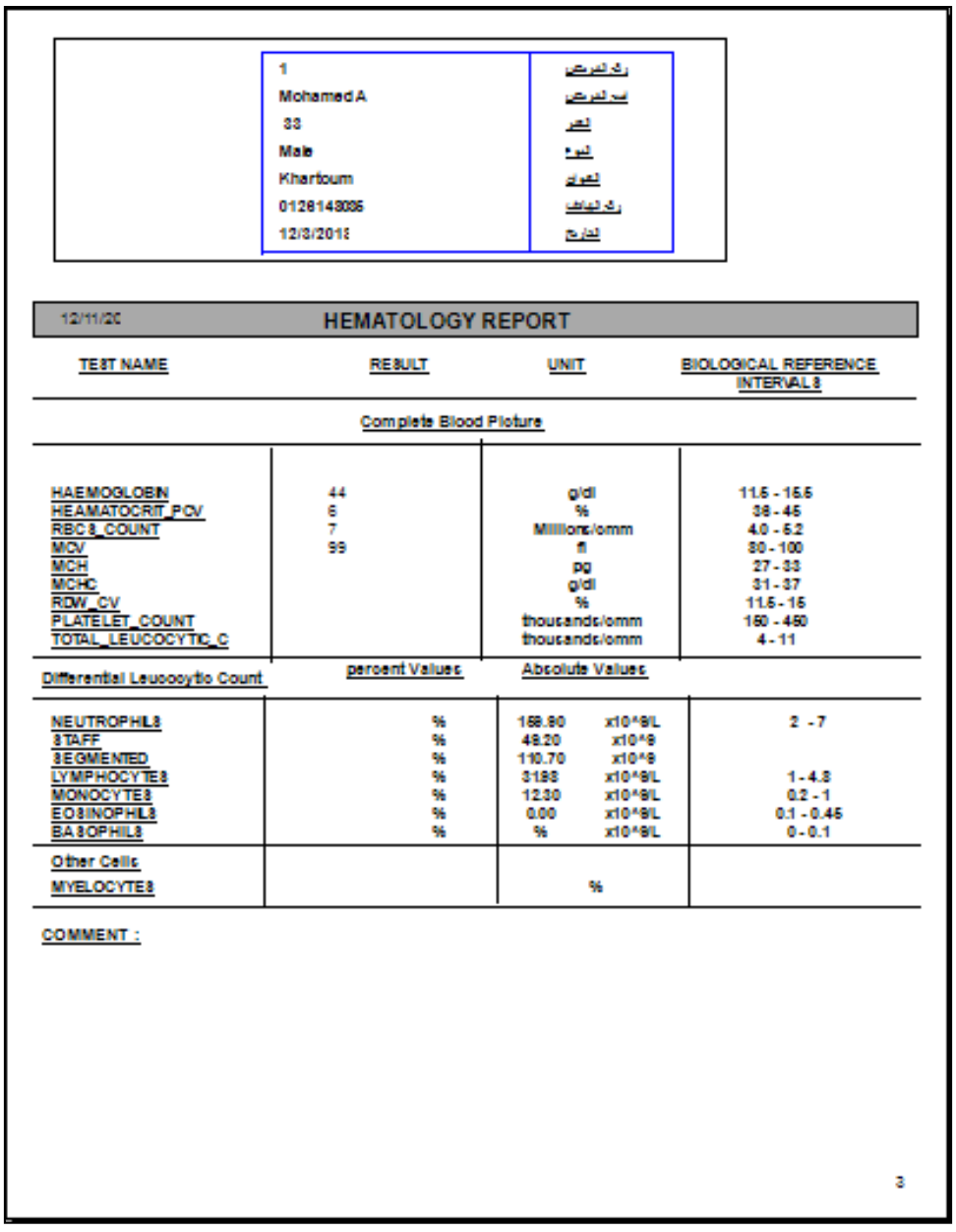


Figure (4.8): Parasitology form of Computerized Laboratory Information System

In the above figure(4.8) the form designed to record the parasitology tests for example the Urine analysis had examinations (Macroscopic Examination and Microscopic Examination) and the differentiate of them.



1	رقم المريض		
Mohamed A	اسم المريض		
33	العمر		
Male	النوع		
Khartoum	العنوان		
0126143036	رقم الهاتف		
12/3/2018	التاريخ		

12/11/20 **HEMATOLOGY REPORT**

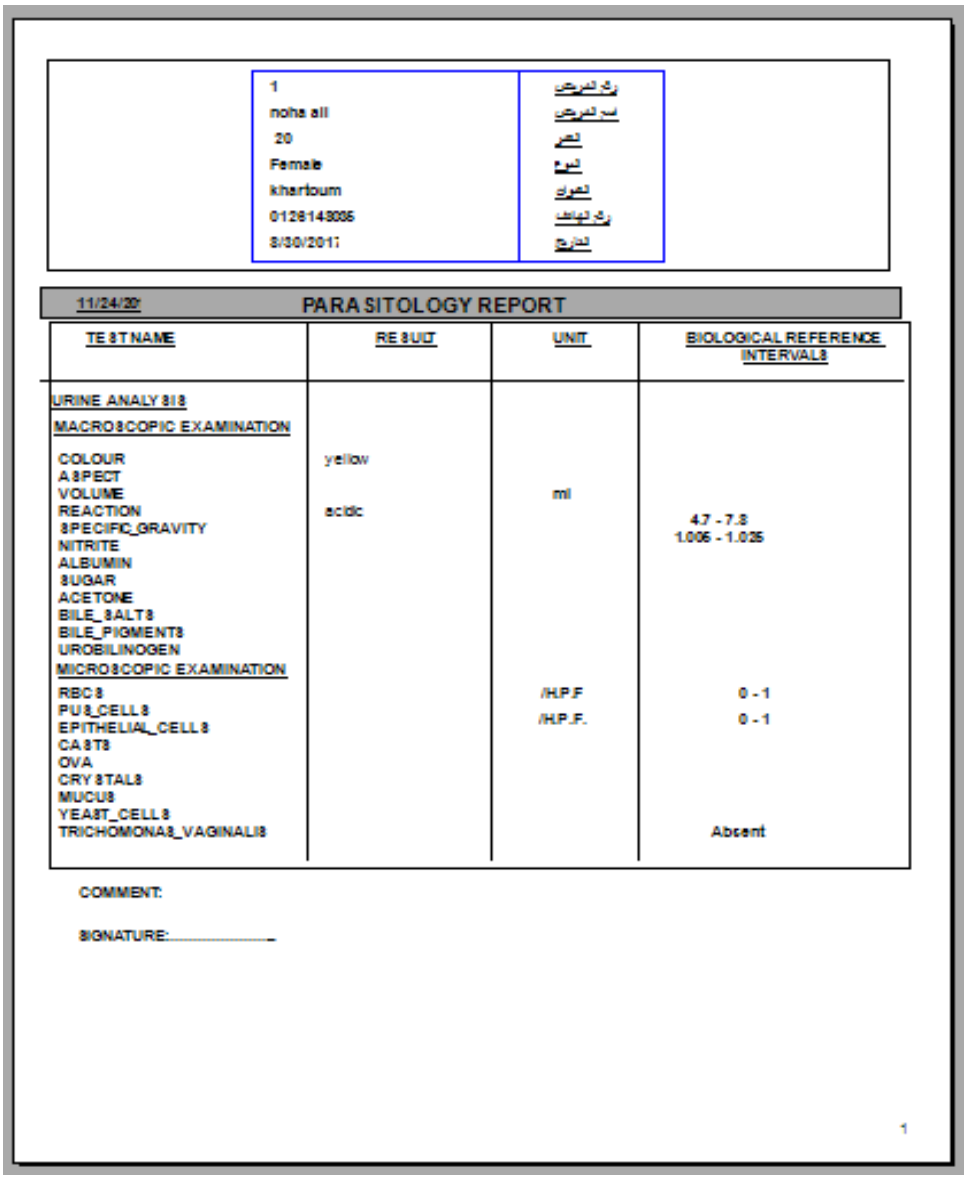
TEST NAME	RESULT	UNIT	BIOLOGICAL REFERENCE INTERVALS
Complete Blood Picture			
HAEMOGLOBIN	44	g/dl	11.5 - 15.5
HEAMATOCRIT_PCV	6	%	38 - 45
RBC'S_COUNT	7	Millions/cmm	4.0 - 5.2
MCV	99	fl	80 - 100
MCH		pg	27 - 33
MCHC		g/dl	31 - 37
RDW_CV		%	11.5 - 15
PLATELET_COUNT		thousands/cmm	150 - 450
TOTAL_LEUCOCYTIC_C		thousands/cmm	4 - 11
Differential Leucocytic Count	percent Values	Absolute Values	
NEUTROPHILS	%	158.90 x10^9/L	2 - 7
STAFF	%	48.20 x10^9	
SEGMENTED	%	110.70 x10^9	
LYMPHOCYTES	%	3188 x10^9/L	1 - 4.8
MONOCYTES	%	12.80 x10^9/L	0.2 - 1
EOSINOPHILS	%	0.00 x10^9/L	0.1 - 0.45
BASOPHILS	%	% x10^9/L	0 - 0.1
Other Cells			
MYELOCYTES		%	

COMMENT :

3

Figure (4.9): Hematology report.

The figure(4,10) the form designed to record the Hematology test's result and the limitation of result(biological limit intervals) and the units.



1	رقم المريض
noha ali	اسم المريض
20	العمر
Female	النوع
khartoum	العنوان
0126143035	رقم الهاتف
8/30/2017	التاريخ

11/24/20

PARA SITOLOGY REPORT

TEST NAME	RESULT	UNIT	BIOLOGICAL REFERENCE INTERVALS
URINE ANALYSIS			
MACROSCOPIC EXAMINATION			
COLOUR	yellow		
ASPECT			
VOLUME		ml	
REACTION	acidic		4.7 - 7.8
SPECIFIC_GRAVITY			1.005 - 1.025
NITRITE			
ALBUMIN			
SUGAR			
ACETONE			
BILE_SALTS			
BILE_PIGMENTS			
UROBILINOGEN			
MICROSCOPIC EXAMINATION			
RBCS		/H.P.F	0 - 1
PUS_CELLS		/H.P.F.	0 - 1
EPITHELIAL_CELLS			
CASTS			
OVA			
CRYSTALS			
MUCUS			
YEAST_CELLS			
TRICHOMONAS_VAGINALIS			Absent

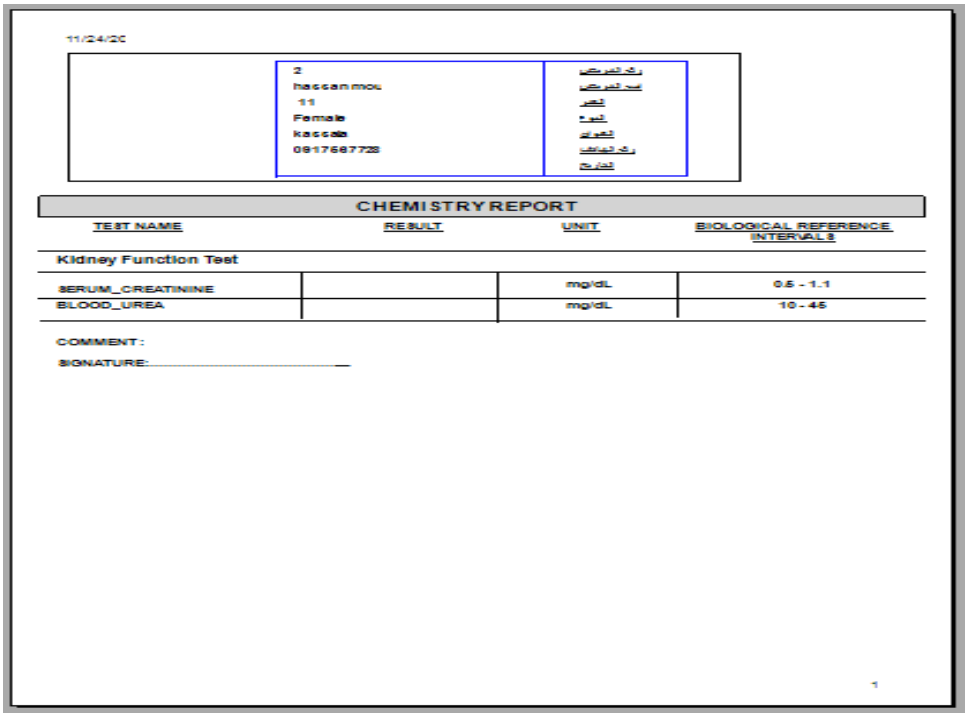
COMMENT:

SIGNATURE:_____

1

Figure (4.10): Parasitology report.

The figure(4,10) the form designed to record the parasitology test's result and the limitation of result(biological limit intervals) and the units.


11/24/20

2
hassan mou
11
Female
kassala
0917687728

CHEMISTRY REPORT

TEST NAME	RESULT	UNIT	BIOLOGICAL REFERENCE INTERVALS
Kidney Function Test			
SERUM_CREATININE		mg/dL	0.5 - 1.1
BLOOD_UREA		mg/dL	10 - 45

COMMENT :

SIGNATURE:

1

Figure (4.11):Chemistry result

The figure (4.9) the form designed to record the chemistry test's result and the limitation of result(biological limit intervals) and the units.

Chapter Six

Chapter Six

Conclusion and Recommendation

6.1 Conclusion:

In conclusion ,the system should not be permitted security procedures and should be arranged to avoid the use of the computer for games and other non-medical record functions to protect the computer from viruses and authorized staff should be issued with passwords, which are changed regularly to prevent unauthorized access. The system present information based on the results of a survey of CLIMS users and determine the needs of the systems.

- Computerized laboratory Information System Requirements:

Before planning the system, many administrative decisions must be made. Some important ones included sufficient funds are available for its development and implementation, the type and size of computer required and that sufficient computer terminals are available to meet the needs within the funds available, trained staff are available to install and maintain the system, the hospital has a computer support team available to assist if hardware or software problems arise, all staff have keyboard and mouse training and are also trained. In the use of the relevant software, a computer terminal is available to the staff and should not be locked away in the manager's office, appropriate furniture is made available (cables, electric cables, chairs and desks). Furniture provided for computers in Medical Record Departments is often taken away by managers for other offices. The special needs to implement CLIS are : C# for database and Visual studio.net source downloaded freely from internet.

- Benefits of Computerized Laboratory Information System:

- Fewer transcription errors and faster processing with direct instruments uploads.

- Real time control of data quality with built in QC criteria.

- Direct report generalization meeting specific client requirements.

- Direct electronic reporting to client or direct client to access to data.

6.2 Recommendation:

We recommended : To apply this system internally in Sudanese hospitals to reduce errors in primary source data , as**,** It is to be entered immediately at the point of care by the health professional , or automatically by clinical monitoring tools, To apply the system at the country level by WAN networks to reduce poor quality data from hospital services due to reporting through provision of primary source data , eliminating the need for potentially adapted aggregated data, providing a central repository for clinically relevant information and supporting data collection used for secondary uses (for examples research), Recommend to expand the system to include all hospital managements like ICU and OR scheduling system billing and financial purposes, The ministry of health in force hospitals can apply a CMR system to organize doctors works and drugs supply.

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Appendix:
Code

REGISTRATION FORM

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Windows.Forms;
using System.Data.SqlClient;


namespace test
{
   public partial class FRM_REG : Form
   {
      SqlConnection sqlcon=new SqlConnection(@"Server=.\SQLEXPRESS; Database=DB; Integrated
Security=True");
      SqlDataAdapter da;
      DataTable dt = new DataTable();
      SqlCommandBuilder cmdb;
      BindingManagerBase bmb;
        public FRM_REG()
      {

         InitializeComponent();
         da = new SqlDataAdapter("Select * from TBL_PATIENTS", sqlcon);
         da.Fill(dt);
         dataGridView1.DataSource = dt;
         txt1.DataBindings.Add("text", dt, "PNO");
         txt2.DataBindings.Add("text", dt, "PNAME");
         txt3.DataBindings.Add("text", dt, "AGE");
         cb.DataBindings.Add("text", dt, "TAYPE");
         txt4.DataBindings.Add("text", dt, "ADDRESS");
         txt5.DataBindings.Add("text", dt, "PHONE");
         txt6.DataBindings.Add("text", dt, "DATE");
         bmb = this.BindingContext[dt];
         btn_add.Enabled = false;



      }

      private void button7_Click(object sender, EventArgs e)
      {
         Close();
      }

      private void button6_Click(object sender, EventArgs e)
      {
         this.Hide();
         Form1 frm = new Form1();
```

```
    frm.ShowDialog();
}

private void button1_Click(object sender, EventArgs e)
{
    this.Hide();
    Form2 frm = new Form2();
    frm.ShowDialog();
}

private void textBox7_TextChanged(object sender, EventArgs e)
{

}

private void button3_Click(object sender, EventArgs e)
{
    bmb.EndCurrentEdit();
    cmdb = new SqlCommandBuilder(da);
    da.Update(dt);
    MessageBox.Show("تمت عملية الاضافة بنجاح الرجاء الانتظار حتي تتم عملية طباعة التذكرة");
    btn_add.Enabled = false;
    btn_new.Enabled = true;
    RPT.RPT_TAKIT MYREPORT = new test.RPT.RPT_TAKIT();
    MYREPORT.SetParameterValue("@id", this.dataGridView1.CurrentRow.Cells[0].Value.ToString());
    RPT.FRM_RPT FRM = new test.RPT.FRM_RPT();
    FRM.crystalReportViewer1.ReportSource = MYREPORT;
    FRM.ShowDialog();
}

private void button8_Click(object sender, EventArgs e)
{
    try
    {
        bmb.AddNew();
        btn_add.Enabled = true;
        btn_new.Enabled = false;
        int id = Convert.ToInt32(dt.Rows[dt.Rows.Count - 1][0]) + 1;
        txt1.Text = Convert.ToString(id);
    }
    catch
    {
        MessageBox.Show("قاعدة البيانات خالية قم بي اضافة مريض");
        btn_add.Enabled = true;
        txt1.Text = "1";
    }
}

private void txt1_TextChanged(object sender, EventArgs e)
{

}

private void button4_Click(object sender, EventArgs e)
{
    try
    {
        bmb.RemoveAt(bmb.Position);
        bmb.EndCurrentEdit();
        cmdb = new SqlCommandBuilder(da);
```

```
            da.Update(dt);
            MessageBox.Show("  تمت عملية الحذف بنجاح");
        }
        catch
        {
            MessageBox.Show("فشلت العملية");
        }
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Windows.Forms;

namespace WindowsFormsApplication4
{
    public partial class Form1 : Form
    {
        public Form1()
        {
            InitializeComponent();
        }

        private void Form1_Load(object sender, EventArgs e)
        {

        }
    }
}


namespace WindowsFormsApplication4
{
    partial class Form1
    {
        /// <summary>
        /// Required designer variable.
        /// </summary>
        private System.ComponentModel.IContainer components = null;

        /// <summary>
        /// Clean up any resources being used.
        /// </summary>
        /// <param name="disposing">true if managed resources should be disposed; otherwise, false.</param>
        protected override void Dispose(bool disposing)
        {
            if (disposing && (components != null))
            {
                components.Dispose();
            }
            base.Dispose(disposing);
        }

        #region Windows Form Designer generated code

        /// <summary>
        /// Required method for Designer support - do not modify
        /// the contents of this method with the code editor.
```

```
        /// </summary>
        private void InitializeComponent()
        {
            this.SuspendLayout();
            //
            // Form1
            //
            this.AutoScaleDimensions = new System.Drawing.SizeF(6F, 13F);
            this.AutoScaleMode = System.Windows.Forms.AutoScaleMode.Font;
            this.ClientSize = new System.Drawing.Size(284, 261);
            this.Name = "Form1";
            this.Text = "Form1";
            this.Load += new System.EventHandler(this.Form1_Load);
            this.ResumeLayout(false);

        }

        #endregion
    }
}
```

PARASITOLOGY FORM:

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Windows.Forms;
using System.Data.SqlClient;

namespace test
{
   public partial class FRM_PARA : Form
   {
      SqlConnection sqlcon = new SqlConnection(@"Server=.\SQLEXPRESS; Database=DB; Integrated
Security=True");
      SqlDataAdapter da;
      DataTable dt = new DataTable();
      SqlCommandBuilder cmdb;
      BindingManagerBase bmb;
      public FRM_PARA()
      {
         InitializeComponent();
         da = new SqlDataAdapter("Select * from TBL_PARA", sqlcon);
         da.Fill(dt);
         dataGridView1.DataSource = dt;
         TXT1.DataBindings.Add("text", dt, "LNO");
         TXT2.DataBindings.Add("text", dt, "PNO");
         TXT3.DataBindings.Add("text", dt, "COLOUR");
         TXT4.DataBindings.Add("text", dt, "ASPECT");
         TXT5.DataBindings.Add("text", dt, "VOLUME");
         TXT6.DataBindings.Add("text", dt, "REACTION");
         TXT7.DataBindings.Add("text", dt, "SPECIFIC_GRAVITY");
         TXT8.DataBindings.Add("text", dt, "NITRITE");
         TXT9.DataBindings.Add("text", dt, "ALBUMIN");
         TXT10.DataBindings.Add("text", dt, "SUGAR");
         TXT11.DataBindings.Add("text", dt, "ACETONE");
         TXT12.DataBindings.Add("text", dt, "BILE_SALTS");
         TXT13.DataBindings.Add("text", dt, "BILE_PIGMENTS");
         TXT14.DataBindings.Add("text", dt, "UROBILINOGEN");
         TXT15.DataBindings.Add("text", dt, "RBCS");
         TXT16.DataBindings.Add("text", dt, "PUS_CELLS");
         TXT17.DataBindings.Add("text", dt, "EPITHELIAL_CELLS");
         TXT18.DataBindings.Add("text", dt, "CASTS");
         TXT19.DataBindings.Add("text", dt, "OVA");
         TXT20.DataBindings.Add("text", dt, "CRYSTALS");
         TXT21.DataBindings.Add("text", dt, "MUCUS");
         TXT22.DataBindings.Add("text", dt, "YEAST_CELLS");
         TXT23.DataBindings.Add("text", dt, "TRICHOMONAS_VAGINALIS");


         bmb = this.BindingContext[dt];
      }

      private void button4_Click(object sender, EventArgs e)
      {
         this.Hide();
```

```
}

private void FRM_PARA_Load(object sender, EventArgs e)
{

}

private void btn_new_Click(object sender, EventArgs e)
{
    try
   {
      bmb.AddNew();

      int id = Convert.ToInt32(dt.Rows[dt.Rows.Count - 1][0]) + 1;
      txt1.Text = Convert.ToString(id);
   }
   catch
   {
      MessageBox.Show("مريض اضافة بي قم خالية البيانات قاعدة");

      txt1.Text = "1";
   }

}

private void button1_Click(object sender, EventArgs e)
{

   try
   {
      bmb.EndCurrentEdit();
      cmdb = new SqlCommandBuilder(da);
      da.Update(dt);
      MessageBox.Show("بنجاح  التعديل عملية تمت");
   }
   catch
   {
      MessageBox.Show("سليم بشكل الحقول مل من تاكد");
   }
}

private void button3_Click(object sender, EventArgs e)
{
   try
   {
      bmb.EndCurrentEdit();
      cmdb = new SqlCommandBuilder(da);
      da.Update(dt);
      MessageBox.Show(" الفحص اضافة تمت");
   }
   catch
   {
      MessageBox.Show("متوفر غير المريض رقم او المريض رقم من تاكد");
   } }}}
```

HEMAYOLOGY FORM:

```
using System;

using System.Collections.Generic;

using System.ComponentModel;

using System.Data;

using System.Drawing;

using System.Linq;

using System.Text;

using System.Windows.Forms;

using System.Data.SqlClient;


namespace test

{

   public partial class FRM_HEMO : Form

   {

      SqlConnection sqlcon = new SqlConnection(@"Server=.\SQLEXPRESS; Database=DB; Integrated Security=True");

      SqlDataAdapter da;

      DataTable dt = new DataTable();

      SqlCommandBuilder cmdb;

      BindingManagerBase bmb;

      public FRM_HEMO()

      {

         InitializeComponent();

         da = new SqlDataAdapter("Select * from TBL_HEMO", sqlcon);

         da.Fill(dt);
```

```
    dataGridView1.DataSource = dt;

    txt1.DataBindings.Add("text", dt, "LNO");

    TXT2.DataBindings.Add("text", dt, "PNO");

    TXT3.DataBindings.Add("text", dt, "HAEMOGLOBIN");

    TXT4.DataBindings.Add("text", dt, "HEAMATOCRIT_PCV");

    TXT5.DataBindings.Add("text", dt, "RBCS_COUNT");

    TXT6.DataBindings.Add("text", dt, "MCV");

    TXT7.DataBindings.Add("text", dt, "MCH");

    TXT8.DataBindings.Add("text", dt, "MCHC");

    TXT9.DataBindings.Add("text", dt, "RDW_CV");

    TXT10.DataBindings.Add("text", dt, "PLATELET_COUNT");

    TXT11.DataBindings.Add("text", dt, "TOTAL_LEUCOCYTIC_COUNT");

    TXT12.DataBindings.Add("text", dt, "NEUTROPHILS");

    TXT13.DataBindings.Add("text", dt, "STAFF");

    TXT14.DataBindings.Add("text", dt, "SEGMENTED");

    TXT15.DataBindings.Add("text", dt, "LYMPHOCYTES");


    TXT16.DataBindings.Add("text", dt, "MONOCYTES");

    TXT17.DataBindings.Add("text", dt, "EOSINOPHILS");

    TXT18.DataBindings.Add("text", dt, "BASOPHILS");

    TXT19.DataBindings.Add("text", dt, "MYELOCYTES");


    bmb = this.BindingContext[dt];

}
```

```
private void button4_Click(object sender, EventArgs e)
{
    this.Hide();
}

private void btn_new_Click(object sender, EventArgs e)
{
    try
    {
        bmb.AddNew();

        int id = Convert.ToInt32(dt.Rows[dt.Rows.Count - 1][0]) + 1;
        txt1.Text = Convert.ToString(id);
    }
    catch
    {
        MessageBox.Show("قاعدة البيانات خالية قم بي اضافة مريض");

        txt1.Text = "1";
    }
}

private void button3_Click(object sender, EventArgs e)
{
    try
    {
```

```
        bmb.EndCurrentEdit();
        cmdb = new SqlCommandBuilder(da);
        da.Update(dt);
        MessageBox.Show("تمت اضافة الفحص ");
    }
    catch
    {
        MessageBox.Show("تاكد من رقم المريض او رقم المريض غير متوفر");
    }
}

private void button1_Click(object sender, EventArgs e)
{

    try
    {
        bmb.EndCurrentEdit();
        cmdb = new SqlCommandBuilder(da);
        da.Update(dt);
        MessageBox.Show("تمت عملية التعديل  بنجاح");
    }
    catch
    {
        MessageBox.Show("تاكد من مل الحقول بشكل سليم");
    }}}}
```

CHEMISTRY FORMS:

```
using System;

using System.Collections.Generic;

using System.Data.SqlClient;

using System.ComponentModel;

using System.Data;

using System.Drawing;

using System.Linq;

using System.Text;

using System.Windows.Forms;

using System.Data.SqlClient;


namespace test

{

   public partial class FRM_CHEM : Form

   {

      SqlConnection sqlcon = new SqlConnection(@"Server=.\SQLEXPRESS; Database=DB; Integrated Security=True");

      SqlDataAdapter da;

      DataTable dt = new DataTable();

      SqlCommandBuilder cmdb;

      BindingManagerBase bmb;

      public FRM_CHEM()

      {

         InitializeComponent();

         da = new SqlDataAdapter("Select * from TBL  CHEM". sqlcon);
```

```
    da.Fill(dt);
    dataGridView1.DataSource = dt;
    txt1.DataBindings.Add("text", dt, "LNO");
    TXT2.DataBindings.Add("text", dt, "PNO");
    TXT3.DataBindings.Add("text", dt, "SERUM_CREITNINE");
    TXT4.DataBindings.Add("text", dt, "BLOOD_UREA");

    bmb = this.BindingContext[dt];
}

private void button4_Click(object sender, EventArgs e)
{
    this.Hide();
}

private void btn_new_Click(object sender, EventArgs e)
{
    try
    {
        bmb.AddNew();

        int id = Convert.ToInt32(dt.Rows[dt.Rows.Count - 1][0]) + 1;
        txt1.Text = Convert.ToString(id);
    }
    catch
    {
```

```
        MessageBox.Show("قاعدة البيانات خالية قم بي اضافة مريض");


        txt1.Text = "1";
    }
}

private void button3_Click(object sender, EventArgs e)
{
    try
    {
        bmb.EndCurrentEdit();
        cmdb = new SqlCommandBuilder(da);
        da.Update(dt);
        MessageBox.Show(" تمت اضافة الفحص");
    }
    catch
    {
        MessageBox.Show("تاكد من رقم المريض او رقم المريض غير متوفر");
    }
}

private void button1_Click(object sender, EventArgs e)
{

    try
    {
```

```
            bmb.EndCurrentEdit();
            cmdb = new SqlCommandBuilder(da);
            da.Update(dt);
            MessageBox.Show("تمت عملية التعديل بنجاح");
        }
        catch
        {
            MessageBox.Show("تاكد من مل الحقول بشكل سليم");
        }

    }
  }
}
```