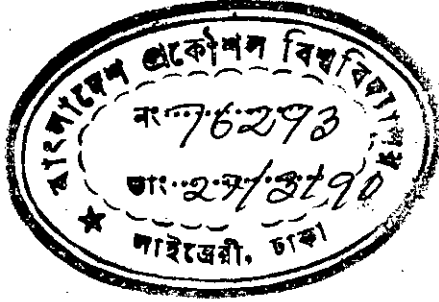


DESIGN OF A HOSPITAL INFORMATION SYSTEM



A project report

by

S M IQBAL

Submitted to the Department of Computer Science and Engineering of Bangladesh University of Engineering and Technology, Dhaka in partial fulfilment of the requirements for the degree

of

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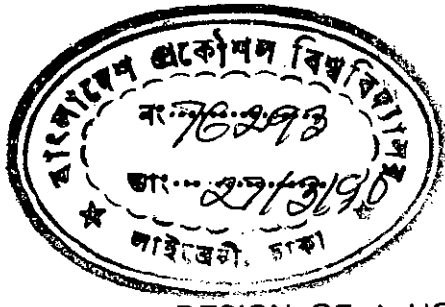
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ABSTRACT

In designing a Hospital Information System entity-relationship is used and it is extended to include both structural and dynamic properties of data. The design process is comprised of two main steps - logical design and physical design. Behavior of entities of Hospital Information System was considered at the logical phase of the design. The Hospital Information System is designed to be installed in microcomputer and is implemented in dBASE-IV/SQL program. As the system is basically a file management system, each of the entities and their relationship is translated into a convenient dBASE-IV/SQL file under a single database. At the beginning an opening menu helps the user to select various aspects of hospital activities. On selection of Patient Admission it is possible to admit a patient to a vacant bed. If Inhouse Patient care is selected monitoring of Patient's Condition, Medicare, Pathological condition and Data entry for these are possible. In Administrative control mainly Duty schedules and Ward information is maintained. The program allows the users to process queries in SQL. The interactive part of the system was implemented in pure dBase and it has relieved the user from learning programming language for regular query processing & data entry. Reduction of paper works to a considerable degree, expanding the span of control of the staff member of the hospital and thus minimizing the expenditure is also a major attraction of the system.

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CHAPTER – 1

INTRODUCTION

1.1 Beginning

The logical view of the data has been an important issue in the recent years. The behavioral analysis of data concerns itself with entities. When these entities exist, they change in a discrete or continuous manner until such time that their existence is lost. Things in the real world change over the time therefore a database system must change accordingly. It is the need to keep track of the dynamic nature of an entity which is often the prime motivation for including it in a data processing system. The dynamic behavior of data has received little or almost no attention in the past. As such previous work on system information modeling had concentrated almost exclusively on static view of the enterprise being modeled and thus it was restricted to a time slice.

In recent times several approaches have been proposed for analysis and modeling of the behavior of data. These models have their own strength and weakness. The network model provides a more natural view of data by separating entities and relationships (to a certain extent), but its capability to achieve data independence has been challenged. The relational model is based on relational theory and can achieve a high degree of data independence, but it may lose some important semantic information about the real world. The hierarchical (entity set) model is the most natural view of data in the context of real world and provides high degree of data independence and based on set theory. But its viewing may not be natural to some people. The above models have used interaction oriented approach, wherein the interaction between the application and the environment is described as well as the causes of changes in the application, each used different representation techniques. The approach that has been adopted in this project is the extended entity relationship or EER data model. The entity-relationship or ER model has the purpose of representing the real world in a pure and natural way so that it is independent of storage and efficiency consideration (Chen, 1985).

The idea of this is to concentrate on the design of the conceptual schema – an intermediate stage in the logical design of a database.

The real world environment is perceived and is expressed in terms of entities and relationships among them. Thus an ER model is constructed using the three underlying concepts (a) entities, (b) relationships, and (c) attributes. Entity is assumed to be a thing that exists through perception and the enterprise to be modeled has interest on it. Relationship describes how the entities are associated. Attribute describes character of an entity or it may be said as the property of an entity type.

ER approach in modeling of real world environment is very popular because it is very easy to understand and easy to use. Industries and research communities have been attracted to the semantic expressiveness of this approach, because it is an effective tool between end-user and database designers in specifying the user information requirements.

1.2 The Hospital Information System: An Overview

A medium sized hospital with a common organizational plan has been considered in the project and interest of the project is concentrated on its information system.

Ideally it has a counter for incoming patients where an incoming patient can collect an outpatient slip to consult a doctor. As per the doctor's advice the patient may either take prescription and purchase medicines or report to inpatient counter and may seek admission. The hospital has many beds organized in wards. Doctors and other hospital staff work in these wards. The general physicians take full time care of the patients in ward whereas specialists takes some round visits and specially prescribe medicine to the critical patient. General physicians also prescribe medicine in case of emergency. Nurses administer medicine as per doctor's advice. Pathological tests and X-Rays as advised by the physicians are carried outside. But reports are subsequently received in the hospital for later use. The hospital also have an administrative office which is responsible for doctor's duty schedule and control other day to day activities.

This project choose the Dhaka Hospital of the International Center for Diarrhoeal Disease Research, Bangladesh as its case study. This hospital is organized in different wards and handle outpatients and inpatients and is basically the same as described above.

1.3 Statement of the Problem

The hospital employees have to manage a huge number of paper every day and thus have little time to take care of patients which make it difficult to ensure top quality service.

The Hospital Information System developed here will reduce repeatable paper works. The nurses and doctors need not to search a huge bundle of papers in order to assess the condition of a patient or to know about the dose of a drug or the time of its administration. Administration of the hospital will be able to know the duty timing schedule of the employees and their duty locations. Management of the patient will receive due attention if the system is properly used. The information will be up to date and access to this information is possible more easily and more accurately. Data retrieval for research and medico-legal purposes will be faster and more dependable. Most important of all, the hospital services become more effective because it can maintain its standard of quality and service.

This study is carried out to fill the need for a computerized information system for medium sized hospitals.

Activities of a hospital change rapidly over any span of time of a day. New patients come in, get discharged, new tests on the patients are performed. Changes may also take place in diagnosis or medicine administration. It is therefore necessary to analyze the dynamic structure of the data and model the data accordingly to its behavior in difference of time.

1.4 Objectives

The general goal of this project is to design and develop a microcomputer based information system for medium sized hospital or large clinics. This may be called a Microcomputer-based Hospital Information System (MHIS). More specifically, the following objectives may be named:

- a) To design a medium sized hospital information system by analyzing and modeling the behavioral structure of data within the hospital.
- b) To translate the design into executable program(s).
- c) To translate some of the time to time interactive queries into executable programs.
- d) To implement the MHIS in microcomputer.

1.5 Scope and Limitation

This study is limited to the following constraints:

- a) Only outpatient consultation, inpatient admission, diagnosis, medicine administration, duty schedule, and personnel information of the hospital staff are included in the system. A limited number of queries and functions are included.
- b) Possible implementation is a medium sized hospital of 300 beds.
- c) Consideration of storage and efficiency are excluded and beyond the scope of the present study.
- d) Computer software and hardware facilities were limited to only those available at the Bangladesh University of Engineering and Technology, Dhaka.

1.6 Project Outline

This project is organized as follows: Section 1 is already described. Section 2 presents the description of available information system. Section 3 describes the design process of the EER approach to system analysis and design. Sections 4 and 5 discuss, respectively, the logical and physical design of the system, with emphasis on the behavioral analysis during the logical system design phase. Section 6 presents the benefit analysis of the system upon implementation. Section 7 is for implementation phase of the system. Section 8 presents the conclusion and directions for future work & research.

1.7 Summary on procedure followed

- 1) Survey of existing systems.

- 2) Study of present events going on in several hospitals – specially that of ICDDR,B.
- 3) Identification of user's queries and requirements.
- 4) System study to develop DFDs.
- 5) Identifications of data stores from DFDs.
- 6) Development of entity relationship diagrams in order to bridge the data stores and to develop relational model. Key or the prime indicators were also identified.
- 7) Space allocation for the attributes/fields of different data stores/entities.
- 8) Benefit analysis and proceedings for implementation.
- 9) Interactive program development.
 - a) The problem of vacant bed identified – the system takes care of it and report to front desk of the hospital.
 - b) Patient care activities is the other area of problem – the system reports the following things in order to ensure proper patient care. i) Pathological test reports summary ii) Medicine Administration summary and special instructions iii) Condition reports and diagnosis summary.
- 10) Development of user's manual on above functions.
- 11) Future study recommendation.

CHAPTER - 2

REVIEW OF SYSTEM

2.1 Existing System Survey

The management system of patients in the hospitals here have their own shapes, which is quite different from the West. It is not easy to change the system within a very short period of time. As such though there are very sophisticated and useful systems available in the developed countries but Bangladesh being a developing one and has her own system so those advanced hospital management oriented information systems are not readily applicable here. There is no community based health system available here. So health services are restricted only to some government hospitals and in the private sector. Because of this situation no Hospital Information System has ever been developed or implemented. Though some hospitals and clinics are using microcomputers for word processing and inventory control. This limited computerization are in fact in little use for patient care activities directly and cannot be termed as Hospital Information System. The reason of this gap is mainly due to the non-availability of a suitably developed ready system.

The International Centre for Diarrhoeal Disease Research (ICDDR) is playing a pioneering role in the computerization of health care activities in Bangladesh. But the organization itself is dedicated to the research of a specific disease, Diarrhoea, so the total computerization of their hospitals, does not come first. However, in ICDDR a demographic surveillance system database is in use for various types research activities related to diarrhoeal disease. The information system is using an IBM 4361 mainframe computer. The organization is also supporting a MCH-FP (Maternity Child Health and Family Planning) extension project using microcomputer based system.

As mentioned earlier there is no global health care system in the country. The patients with their complaints either go to the hospitals or consult a private practitioner with the cost exclusively borne by themselves. The hospitals in general run by the government or some charitable organizations. Indoor patients of the hospitals are either referred cases of the outdoor or patients entered through emergencies. Privately owned clinics are also providing health care facilities. These clinics in general do not have outdoors and houses indoor patients only referred by different private practitioners.

2.2 Behavior Modeling

Information systems have gained wide acceptance and applications so that we are now faced with the problem of how to use these systems effectively. Several approaches and models have been designed to aid in the development of these information systems. The extension of the entity-relationship to allow for behavior analysis and modeling had been discussed by several authors.

Jackson (1975) attempted to show how dynamic system models, as could be defined in SIMULA67, could be programmed in COBOL. This did not receive a great deal of attention because it had been applied only to simple systems with a single entity type and no parallelism.

The work of Robinson (1979) developed a systems behavior modeling method using the technique of Jackson. He applied this to more realistic cases. The standpoint of his research was that the natural representation of a process such as an entity executing a behavior is another process. A process in the computer model was the execution of a program.

The language developed by Broutmann, Falkenberg, and Mauor (1979) had the option of embedding the database instances into the historical time axis. Based on the time handling facilities, both the static properties and dynamic behavior of the conceptual schema instances could be expressed.

A framework outlined by Bracchi, Furtado and Pelagatti (1979) specified and analyzed requirements on the evolution of the database during its life cycle. The methodology was independent of any specific data model or design method but emphasized on the importance of specifying both static and dynamic constraints. Two strategies for enforcing the static and dynamic constraints were suggested - the first by specifying all transactions at the time of design and the second by adding pre-programmed tests and actions to certain user requests.

Jones and Mason (1980) discussed the time dimension in relation to data modeling, updating, and the development of a user interface. They described the approach to the subject incorporated in the legal system and language.

The Active and Passive Component Modeling (ACM/PCM) method for the design and specification of behavioral and structural properties of database transactions was presented by Brodie (1981, 1984). ACM/PCM used the abstraction and localization (bottom-up) concepts. It was based on the concept that control structures (used for organizing programs) were the behavioral counterpart of data structures (used for organizing data).

In defining the dynamic conceptual schema, Rolland (1983) introduced an original global model. The model, called dynamic model, provided elements for construction of the conceptual control of the relationships of time between data and programs. The concepts of objects, events, and operations were introduced and to represent the dynamic dimension of the real world, the relationship between the concepts, namely, modify, induce, and trigger, were also introduced.

Sakai (1983) dealt on the analysis and modeling of the behavior of entities at the conceptual level. He introduced the notion of instantiation to analyze and model the behavior of entities. This behavior was defined as a set of transactions and states that results from transactions.

It was only until recently that there had been a surge of interest in temporal data, perhaps due to the rapidly decreasing cost of memory and magnetic disk storage and the advances in

optical disk technology (Shoshani and Kawagoe, 1986). In the real world, business applications such as banking, sales, inventory control, and reservation systems need to maintain a complete record of operations over the database. This history could be statistically analyzed for decision making purposes. In their paper they developed a framework for the support of time sequences. The details of the design were not defined precisely.

Since this project was concerned more on the behavior of data during the design and analysis phase, the work of Sakai (1983a) seemed appropriate and has been adopted throughout the design process of the Microcomputer-based Hospital Information System.

2.3 Trends and Problems of Logical Database Design

Database design is a difficult task with all its complexities. It is also a time consuming process. If there is lack in usable database design methodology inadequate database results because they cannot satisfy present or future requirements of the organization. Although there is a tremendous advancement of the sophistication of the applications of the database, the development of techniques to support ill-designed database has not advanced comparably.

CHAPTER – 3

APPROACH TO DESIGN

3.1 Design Steps

Having adopted the approach of Sakai, a two main step system design process is proposed: One is the design of the logical system, the other is the design of the physical system.

The logical system designs can be divided into 4 phases.

- 1) Information requirement analysis
- 2) System analysis and specification
- 3) Structural analysis
- 4) Behavioral analysis

3.2 Design of the Logical System

In the following subsection the basic principles of the design of logical system has been described in a nutshell. As mentioned earlier, it is of four phases.

3.2.1 Information Requirement Analysis

The requirement analysis phase is concerned with documenting the organizational needs and enumerating the means to satisfy these needs. It defines all the information to be used in the ensuing system. Information requirements are usually obtained by interviewing people at various levels of the organization, specially the users of the system. This stage delimits the scope of the system and analyses its activities. It is in this phase wherein the environment and requirements of the system are defined and the objectives of the system are specified.

The success of system development depends on how clearly the requirements are defined. The fault of many designers is that information requirements are vaguely stated so that in the end, the system does not satisfy the needs of the organization it serves.

The organization that is of interest in the system is defined first. An organization may be of any nature such as a bank, university, manufacturing plant or a hospital. The whole organization may be considered or selected division and department within the organization may be considered.

3.2.2 System Analysis and Specification

The purpose of the system analysis phase is to structure the requirements in order to produce workable solutions to the problem at hand. The structuring of problem domain facilitates problem solving process. The resulting structure becomes a model of the problem. System analysis was done using the structured analysis approach. The structured approach helps the users and system developers to divide the large and complex problems into smaller and sim-

pler problems that can be solved independently.

The primary tool of the structured analysis is the data flow diagram (DFD). DFD is a graphical tool that represents data flow and transformations in a process. It provides an easy, graphical means of modeling the flow of data through a system, whether it be manual, automated, or a mixture of both. The components of DFD are:

- a) Process or transforms, represented by circles or bubbles. Each process identifies a function that transforms the data.
- b) Data flow, represented by directed arrows. Arrows directed to a process are inputs to that process and arrows directed away from a process are outputs of that process. Arrows to the database represent search argument and arrows from the database represent retrieved information or status.
- c) Sources or sinks of data, represented by rectangular boxes. The source shows where the data required by the system comes from. It is a provider of data flows for the system. The sink shows where the data produced by the system goes. It is a receiver of data flows from the system.
- d) Data stores, represented by two horizontal parallel lines. A data store is a repository of data, e.g. files, graphics layout, etc.

The DFD techniques just show the flow of data in a system without emphasizing the physical or control aspects. It does not indicate any timing consideration or sequence of events in the system, hence, it allows the designer to consider separately the logical attribute of the system from the physical attributes. After a series of consultation with the user, the user requirements concerning those parts which are automated are formalized into descriptions of data, tables, events, and constraints -- the result of which are represented by a DFD.

The system analysis and specification are done in four steps:

- 1) Decomposition
- 2) Refinements
- 3) Identification of database information
- 4) Events description

3.2.2.1 Decomposition

In general the systems are usually large and complex to solve as one unit. It is necessary to classify them into functional subsystems. The entire system is partitioned into smaller subsystems those are simple to specify concisely. Once these subsystems are identified, it is possible to display the information flow among them.

3.2.2.2 Refinements

A simple DFD is usually not enough to depict the flow of data among the different subsystems. Therefore, the DFD is refined in order to subdivide the task into smaller subsystems producing lower level DFDs, the information flow in each subsystem are clearly defined and specified.

3.2.2.3 Database Information

From the information requirement in the DFDs it is necessary to choose the data elements to be included in the database. As some elements are better stored as external files or just maintained as written document, the analysis of the information to be stored in the database should provide a database that really reflects the entities, relationships, and data processing needs of the community. It should be noted that in determining the elements for inclusion in the database, it must be independent of any implementation approach.

3.2.2.4 Event Description

An event specification describes a change in the state of data elements to a point in time related to a specified happening in the enterprise. The state-changes are described in terms of their pre-conditions and post-conditions associated with each operation. State changes are specified by sequence of actions called procedures, processes or functions. The description of events at this early stage consists only of specifying actions at higher level abstract operations. It paves the way to an early understanding in the development of how the future systems operate in production. The next phases of the design define the conceptual schema. The conceptual schema describes all the data of interest to the organization which is to be maintained in the database. It specifies the logical contents of the database and constraints which applies to data. Both static and dynamic requirements of the organization should, however, be represented in this conceptual schema.

3.2.3 Structural Analysis

This is basically an iterative process and proceed as stated below:

- 1) Identification of entity and relationship types
- 2) Drawing of entity-relationship diagrams (ERDs)
- 3) Identification of attributes and prime identifier
- 4) Identification of static and dynamic constraints
- 5) Reviewing and modifying the ERDs using (3) and (4)

3.2.3.1 Entity and Relationship

An entity is a thing which can be distinctly identified in our minds and is of interest to the enterprise (Chen, 1985). Something in the real world may be of interest to the enterprise other one not. It is therefore necessary to choose these entities which are of importance to the company. A relationship is the association of two existing entities. Relationship can be of

three types:

- a) one to one (1:1)
- b) one to many (1:n)
- c) many to many (m:n)

An one-to-one relationship exists when one entity is mapped to the other entity only once. In a one to many relationship, one entity can be assigned to many values of the other entity. Many to many relationship permits many values of one entity to be associated to more than one value of the other entity. There are many types of relationships existing between entities. It is important for the database designer to select and specify these relationship types which are relevant to the organization.

3.2.3.2 ER Diagrams

The entity-relationship diagram (ERD) is a technique used in representing the entities and relationships. The components of ERD are (a) entities, represented by rectangular shaped boxes, (b) relationships, represented by diamond-shaped boxes with lines connecting the related entity types, and (c) type of mapping of the relationship types (one to one, one to many, or many to many), represented by the figures 1,M,N beside the connecting line.

3.2.3.3 Attribute and Values

Properties of entities can be expressed in terms of attribute value pairs. For example, the name of patient x is 'zzzz', the entity patient has an attribute 'name' with value 'zzzz'. The prime identifier are those attributes that uniquely identify the entities. The concept of entity identifiers is similar to that of the 'primary key' in conventional data processing. Relationships are identified by making use of the identifiers of the entities involved in the relationship. Thus, relationship identifiers are the combined entity identifiers that take part in the association.

3.2.3.4 Static and Dynamic Constraints

In specifying and analyzing requirements on the evolution of database during its life cycle, it is important to specify both static and dynamic constraints. Static constraints are formulated from the description of entities, relationships, and attributes. Dynamic constraints are specified from the description of operations, transaction and parameters. The most distinguishing feature of dynamic constraints in their dependence on time. The operations those are considered in the dynamic constraints are create, delete, modify, etc. Transactions are the relationships among operations where both operations and transactions may have parameters.

Four classes of integrity constraints are presented for the static constraints

- a) Existence dependence
- b) Restricted relationship
- c) Relationship mapping

d) Attribute value restrictions

The existence dependence among entities is when the existence of one entity depends on the existence of the other entity. This is also called as the weak entity type by Chen (1983). The dependence of this entity is represented by an arrow pointing to the weak entity. In the restricted relationship, certain restrictions exist between the entities. Relationship mapping is a statement of the maximum number of time an entity of one type is allowed to appear in a relationship between 2 entity types. Attribute value restrictions give restrictions to value of some attributes in an entity.

After these steps, the structural analysis is reviewed and if necessary, modified in order to capture the database requirements. This process goes on until the requirements are satisfied.

3.2.4 Behavioral Analysis

The entities and relationships that are identified have their own life histories. These life histories start from their creation and end in their deletion. It is sometimes desirable to identify what entities or relationships undergo specific changes of state.

Data behavior modeling is performed in four steps:

- 1) Instantiation of entities
- 2) Identification of user queries
- 3) Development of ER behavior diagrams (ERBDs)
- 4) Event specification

3.2.4.1 Instantiation of Entities

The instantiation concept of entities is introduced to describe the evolution of these entities over time. The procedure of the instantiation of an entity set takes the elements of the relationship at a given instance for entities. From a given entity set, an instance over a specified period of time is isolated or abstracted at a lower level. The behavior of this isolated entity is analyzed, both as a separate entity instance or as an entity instance defined over its associated relationship set.

3.2.4.2 User Queries

By analyzing the attributes of an entity set at the lower level by different grouping elements of these attributes from various viewpoints, different reporting forms can be designed. These forms are used to define the user queries.

3.2.4.3 ER Behavior Diagrams

The Petri Net model is used to model the life history of entity and relationship sets. The Petri Net graph is drawn together with an ERD. This diagram is referred to as ER behavior diagram

or ERBD. The ERBD expresses the total behavior of a database which is made up of a collection of the total life histories of entity and relationships.

The elements that make up the ERBD are:

- a) Set of transactions (T_1, \dots, T_n) represented by transition bars. These set of transactions make up the entity and relationship sets.
- b) Set of states, represented by circles. These are also called places.

A set of transaction and states in the same row represents behavior of the associated entity or relationship set appearing in the left hand side.

The development of ERBD proceeds as follows:

- a) Analysis of life history of entities.
- b) Behavior description.
- c) Identification of dynamic degrees and constraints.

Behavior Diagram:

Behavior description of each entity set and relationship set explicitly states the behavior of these sets as described in an ERBD. This description consists of state descriptions and transaction description. state descriptions can be expressed as Boolean expressions with attributes, values, set, or relationship set as their terms. State description include the following:

- a) An element E or R exist or does not exists
exs (E)
nil (E) = .not. exs (E)
exs (R)
nil (R) = .not. exs (R)
- b) values are assigned to attributes (attributes have values)
hv (A_1, \dots, A_n)
- c) values of attributes are changed (attributes have new values)
nv (A_1, \dots, A_n)

E means entity set, R means relationship set, and A_1, \dots, A_n are attributes.

Transaction descriptions may be of the following form:

- 1) s: get (s)
- 2) s: get (R) [through R(S1,...,Sn)]
- 3) s: create (E,state)
- 4) s: create (R,state) [through r(S1,...,Sn)]
- 5) s: modify (s',state)
- 6) s: delete (s')

E means entity set, R means relationship set, S means object space of s namely set of entities or relationships 'got' or 'created' by a simple transaction and 'state' means state to be brought about in case of create and modify operations.

In general, transaction with operation that operate on a different entity or relationship set need to be 'normalized'. Normalization involves associating states brought about by a transaction with only one entity or relationship set.

Dynamic Degrees:

Each life history of the entity and relationship set has varying degrees of dynamic behavior.

- a) Low – Entity and relationship set remain practically static over a life history span. The transactions performed on these sets are limited to one or both: get and modify.
- b) Medium – Entity and relationship set have a long and undefined history span. The transaction performed on these set include all or any of get, create, modify and delete.
- c) High – Entity and relationship set have a relatively short life history and may maintain past histories of instances of the set. The transactions performed on these set include all or any of: get, create, modify and delete.

3.3 Design of Physical System

The second stage of the design process is the design of physical system. This phase addresses the problem of implementing the logical design. The physical system is designed in the manner described below:

- 1) Hardware configuration
- 2) Language implementation
- 3) Input/Output design
- 4) File design
- 5) Program design

3.3.1 Configuration of Hardware

It describes the requirements of the physical structure of hardware for the MHIS to run. It specifies the minimum requirements and peripheral units needed to maintain the system.

3.3.2 Choice of Programming Language

The choice of one language over another is often based on company policy, availability of language in the machine being used, and availability of experienced programmers (Youkdon, 1972). The type application systems may also affect the programming language to be used.

3.3.3 Design of Input and Output

Input design specifies how data is entered into the system for processing. It includes methods for capturing and validating data. Because of interactive nature of MHIS, inputs are entered on line. On line input must be designed such that the data can be corrected and validated at the time of input and can update the file in real time. Common input/output devices used nowadays are the screen and terminals. An important factor in designing the screen layouts is the conversation between the operator and system (Brooks, 1982). The CRT screen should be designed such that the user knows what to do and the next steps to be in an easy and brief way.

Some options for dialogue design that are employed in this system:

- a) Menus – Functions are listed so that all the operator has to do is to select the option or category that he wants to process. This method cuts down operator input keystrokes and a great depth of classification is achieved.
- b) Question and Answer – The system controls the sequence of transactions by a series of questions and prompts. This is useful when operated by persons unskilled or unfamiliar with the application, however, this is a tedious process.
- c) Form filling – The screen displays a form with prompts and the operator fills the block.

Output to user is one of the most important features of the system. The decisions and policies of users are usually based on these outputs. Output devices may be the printer or screen, but in any case, they must produce outputs that are readable and give exact specifications.

3.3.4 File Structure and Organization

A file is an organized collection of related data grouped in individual elements called record (Johnson and Cooper, 1986). a record is a collection of related data identified as the elements of a file. Files are organized in 2 ways, logical or physical. Logical organization arranges data items according to some abstract relationship whereas physical organization arranges data items by the physical adjacency. Two types of file structures are discussed below and these have been used in the development of the Hospital Information System.

3.3.4.1 In an indexed sequential (IS) file

In an indexed sequential (IS) file, data records may be accessed by the value of one or more keys, called the record keys. The unique key is the primary key or record key which is used in adding, deleting or updating the records. The other keys, which may not be unique, are called alternate record keys. These provide alternate access path for retrieval of records only.

IS files may be accessed sequentially (in ascending order of record_key value), randomly (depending on the value specified in one of its record keys), or a combination of both access methods. Two physical files are created during IS file creation. One file contains the record keys and the other file contains the actual data. The advantage of IS processing is that it is more efficient compared to non sequential files. In addition records are addressed by primary keys and then they can be added in sequence without reorganizing the entire file. One major disadvantage of IS processing is that more information must be read to locate a record. Another disadvantage is that processing becomes very inefficient for a very active file because new records are placed in overflow area.

3.3.4.2 Inverted File

Inverted files are useful in improving retrieval power of a system and often used for inquiries with multiple conditions. It is a modification of multilist file.

Finding a record in multilist files with more than one condition involves determining from the indices, which is the shorter chain, following the pointer to read every record in the limited list and examining each record to see if it meets all the conditions. Inverted files do the access more efficiently by inserting into the file an extra level of non-data information called access list or inverted list. The list records the index or pointer to a set of records that had an attribute in common. A major advantage of inverted file is its suitability for queries or file attributes and fast location of records. However, it is more costly to store and maintain inverted files. They are more difficult to update.

3.3.5 Development of Application Software

No matter what type of application area the system is addressed, it is important to bear in mind the user friendliness of this application system, thus the user who had no experience or knowledge on the system can easily use the system without any extensive training. Due to this user friendliness of the system the user will be able to locate most of the problems encountered by during the discharge of his responsibilities and the system will let him know about mistakes, errors, failures etc. either through message or bell. In addition, systems are interactive in nature, that mean the user is guided by the application system on what necessary actions are to be undertaken. The constant request of standard information of end-users creates heavy demands for:

- a) Powerful interactive language
- b) Flexible file management
- c) Versatile report formatting
- d) On line usage information about the system and the data

These demands of the user necessitate a careful program design in order to satisfy them.

3.4 Cost Benefit Analysis

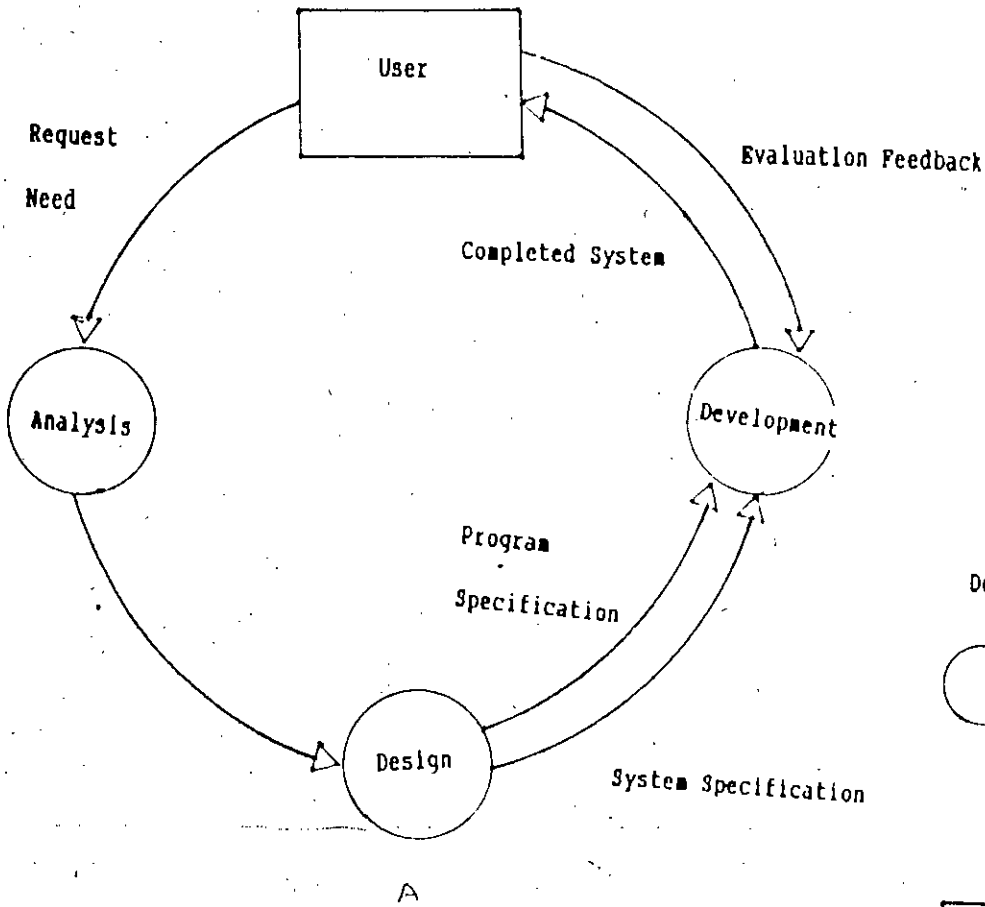
After the completion of the Logical and Physical Phase of design the financial benefit of system is to analyzed in comparison to the existing system and if it is found viable then can easily be recommended for implementation.

3.5 Implementation

This is the last phase of the whole process and the model developed before can be coded by a suitable language. Which can afterwards used to reach the goal and a procedure manual can be prepared to assist the user so that task assigned to him or her becomes easy. A well defined program listing is also an essential part of the process. With the help of this future modification and maintenance of the system becomes less cumbersome.

Figure – 1 represents a summary of the whole process in form of block diagram. "A" part of the figure indicates the position of the design process in respect of the system life cycle. In the part "B" all the steps needed for design are shown.

System life cycle



Design Steps

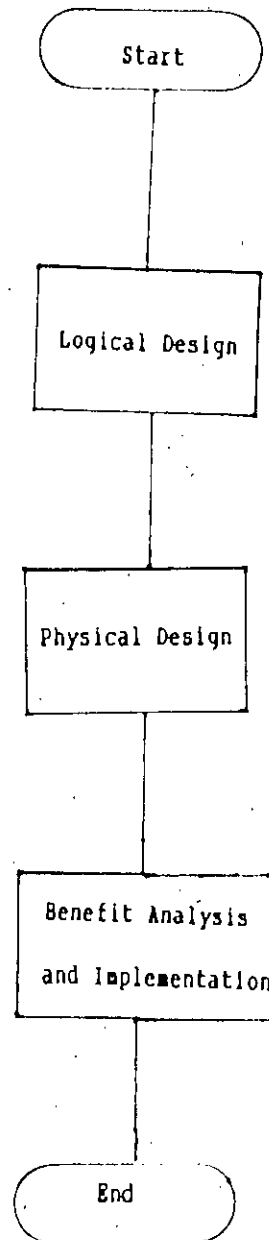


Figure 1
Design and the system life cycle.

CHAPTER - 4

LOGICAL SYSTEM DESIGN

At this stage the environment is defined and requirements and objectives of the hospital is analyzed.

4.1.1 Environment of the Hospital

The organization in this project is the hospital. The environment of the hospital is composed of front desk, wards and administrative office. The front desk provide services to the patients who seek admission to the hospital, their attendants, or the visitors to the hospital. Patients seeking admission means who have been referred for admission into the hospital and required to stay there for a span of time. Patients' attendants mean patients' relatives or friends and in general not hospital staffs. Visitor may be any person who has certain reason to come to the hospital and/or certain queries that he/she wants answered.

Normally patients are referred for admission by the field practitioners or a patient's report to the outdoor of the hospital and the physician attending them suggests admission into the hospital. In most of the cases the patient is accompanied by his relatives or friends as attendant. However, a patient may also come alone. Other than these patients and their associates, other visitors visit the hospital every day. They may be either official or non official. Official visitors may come to assess the performance for hospital facilities for development purpose. Non officials may have some other queries like the chamber of a particular doctor or his telephone number, future admission possibilities or its formalities, ward information, etc.

The hospital consists of several wards with a name and each ward has some beds. Each bed accommodates a single patient. At any point in time some beds may be occupied while some others may not have any patient. Upon receipt of the relevant documents, the front desk operator looks for bed position of the wards of the speciality in which the patient is referred. If no bed are available, the request is either denied or appropriate measure may be taken as settled by the enterprise rule. The hospital under study provides extra beds for such patients. However, this may not be the practice in other hospitals.

The bed once allotted may be canceled or changed to other ward upon the physician's advice or discharge certificate. In the case the bed will be available to the next patient coming for admission. The change of bed to other ward is similar to new admission to that ward.

Once the patient is admitted into a particular ward the activities related to his case starts. His investigation, i.e. pathological tests may be recorded. These might have been done earlier, i.e. prior to the admission into the hospital or current after the advice of the physician. Patient condition writing however starts after the admission of the patient. The patient may have some earlier important condition record important for his future management or treatment purposes. The advise from the physician begins from the start from the date of admission and continues till the occupancy of the bed by the patient. On discharge the patient receives a report on

the pathological tests conducted and medicines administered during his stay. Some of the more useful or interesting data may be preserved for research use.

4.1.2 Requirement Analysis of the Hospital

The main requirement at the front desk is to have a quick picture of bed position in a particular ward.

Specifically, the doctor attending a particular patient is also interested in the patient's pathological findings and patient's observations to arrive at a proper diagnosis and treatment. Pathological reports and Condition data of the patients are to be recorded and kept in the information system in such a manner so that it can be effectively used by the physicians for diagnostic purpose and prescribing medicine.

The nurses attending a patient requires to know about the doses of medicine prescribed by the doctors and its time of administration. Patient diet is also an objective to know. The management wants to keep the duty schedule of other personnel. A variety of medicines may be administered and the patient may have some early record of medicines already administered to him or her. The doctor may also recommend the patient's food as well.

All the doctors have a duty schedule in wards and that covers round the clock attendance. Some specialist doctors have some regular rounds and may attend serious patients upon emergency calls. Nurses and some other staffs also work on the basis of a schedule.

The hospital has a management body to control the activities of its employees. It also has an outdoor section where the patients only receive medicine and go back to their houses. An outpatient, however, can require admission into the hospital if found seriously ill by the duty physician. The hospital authority assumes no responsibility for the patients' condition monitoring or administration of medicine. All these information are required, and require to retrieve it as and when necessary, for patient care and disease diagnostic purpose and the hospital management planning and decision making.

4.1.3 Requirements of MHIS

Considering these information that the hospital patient care and management require daily, manual operations would be tedious and cumbersome. The primary purpose of this information system is, therefore, to ensure easy and fast retrieval of necessary filtered data based on query condition instead of searching into a huge bundle of physical recording documents i.e to save time so that more time could be given to talk to, listen to and serve the patient. Another purpose of the system is to assist management in smooth operation through better administrative control and thus maximize revenue.

4.1.4 System Requirements

The requirements of the hospital information system are:

- a) A database to store all necessary information of patients' admission, diagnosis, medicines given, observations made, and information related to staffs and wards.
- b) Easy update and retrieval of the information from the database.
- c) Reports as and when required and daily reports.
- d) Statistical inquiries on occupancy and projections.
- e) Occupancy chart throughout a year.

Figure 2 gives a summarised breakup of these system requirements. The hospital is depicted as a whole organization (represented by a circle) whose information needs are represented by ingoing arrows to the circle and a pair of parallel lines for data inputs. Some identified activities of the hospital organization are given in circle. They are the supplied information (indicated by ingoing arrows to the circle) to provide the hospital personnel with the required information (shown by the outgoing arrows from the circle) for patient care and administrative purposes.

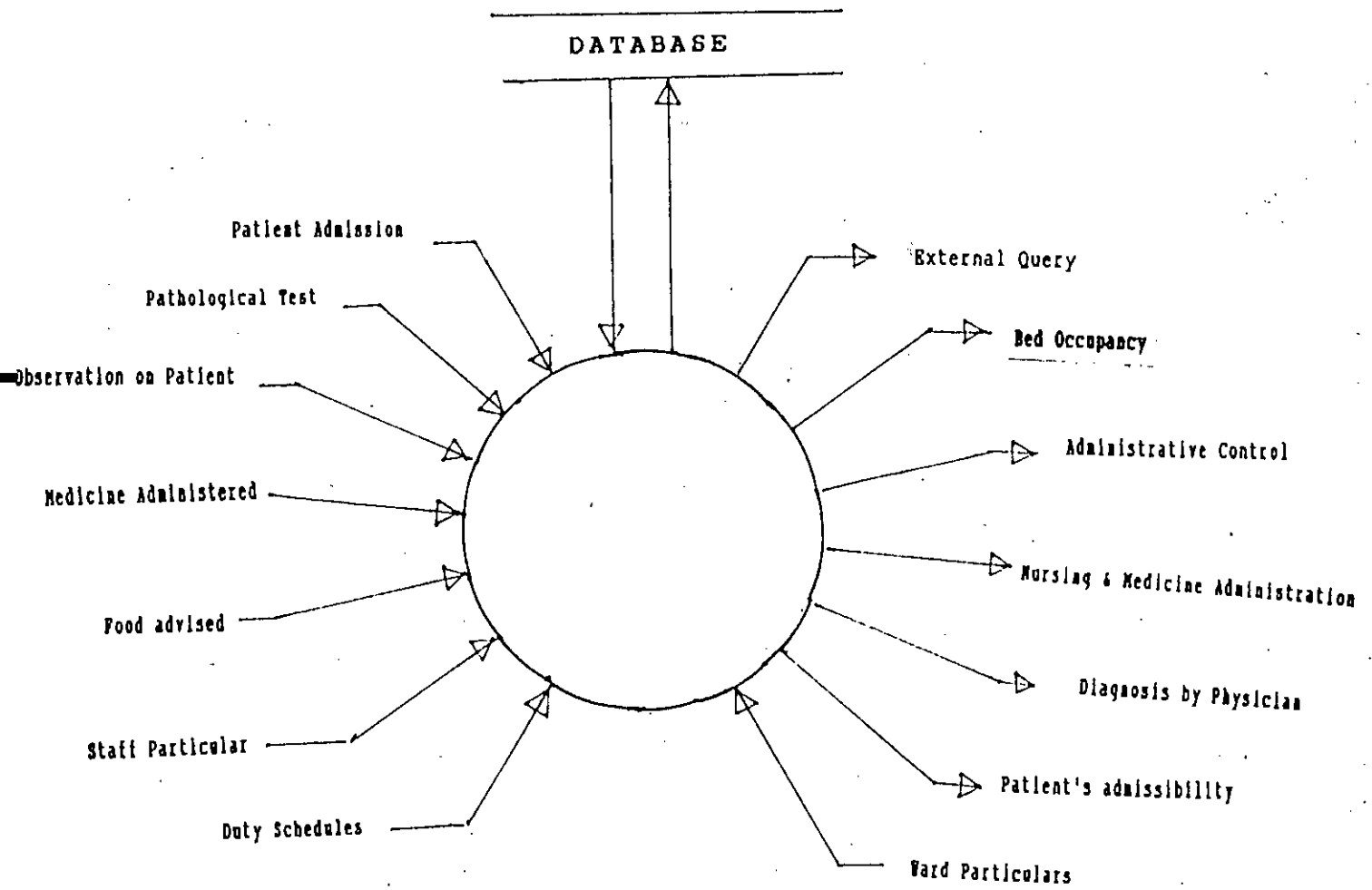


Fig - 2
System Requirement of a Hospital Information System

4.1.5 Functional Specification

The major functions of the Hospital Information System are:

- a) Process of admission and discharge operation at front desk.
- b) Process of diagnosis and Medicare at the ward.
- c) Process of administrative control at management office or with in the hospital office.

4.2 System Analysis and Specification

This phase collects the user requirements concerning those parts of the Hospital Information System which are to be automated and formalize them into description of data, tasks, events and constraints.

4.2.1 Decomposition

The first level data_flow_diagram (DFD) of Figure 3 displays the information flow among the three tasks: Front desk operation, Ward operation and Management operations. The dashed lines delimit the functional subsystem within a selected area. Subsystems outside this area (i.e. outside the marked boundaries) are not the concern of this project and thus do not affect the analysis.

4.2.2 Refinement

A single DFD is not sufficient to depict the flow of data of the three tasks, thus, further subdivisions are done to produce lower level DFDs. Each task is expanded into several subtasks as shown in Figures 4 to 6. The numbers in the lower portion of the bubbles indicate task number.

The second level DFD of process Front Desk Operations consists of two sub-tasks Fig-4 (1.1 and 1.2) namely change admission and cancel reservation. Similarly patient care and medicine administration have four sub-tasks Fig-5 (2.1 to 2.4). There are patient condition registration, updating medicine, create medicine, create pathological test. The process Administrative control has three sub-tasks Fig-6 (3.1 to 3.3) and these are: Change & Update Duty Schedule and Update Ward Data.

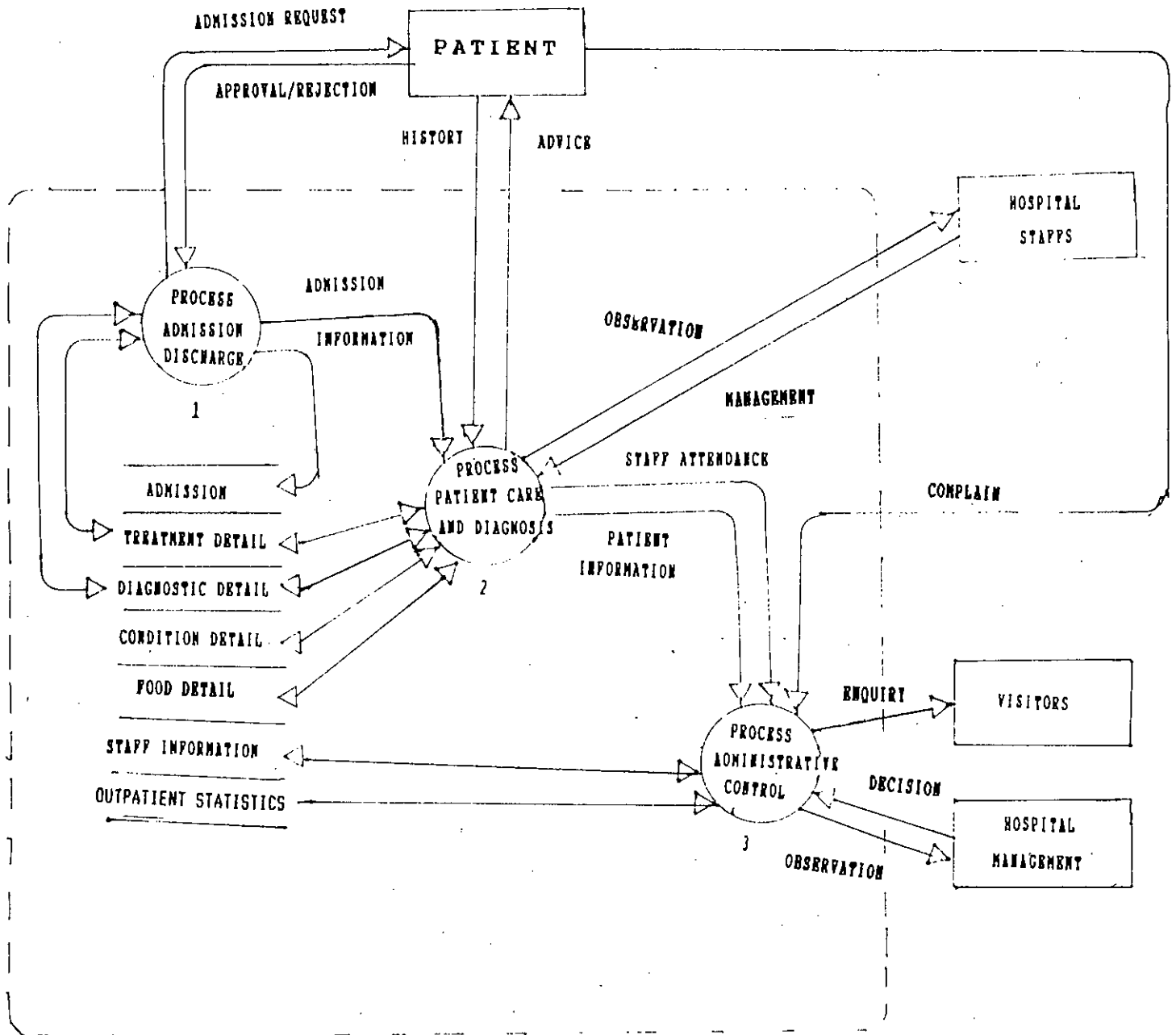


Fig3. First level of DPD for Front desk, Patient care and Administrative operations of a small sized Hospital.

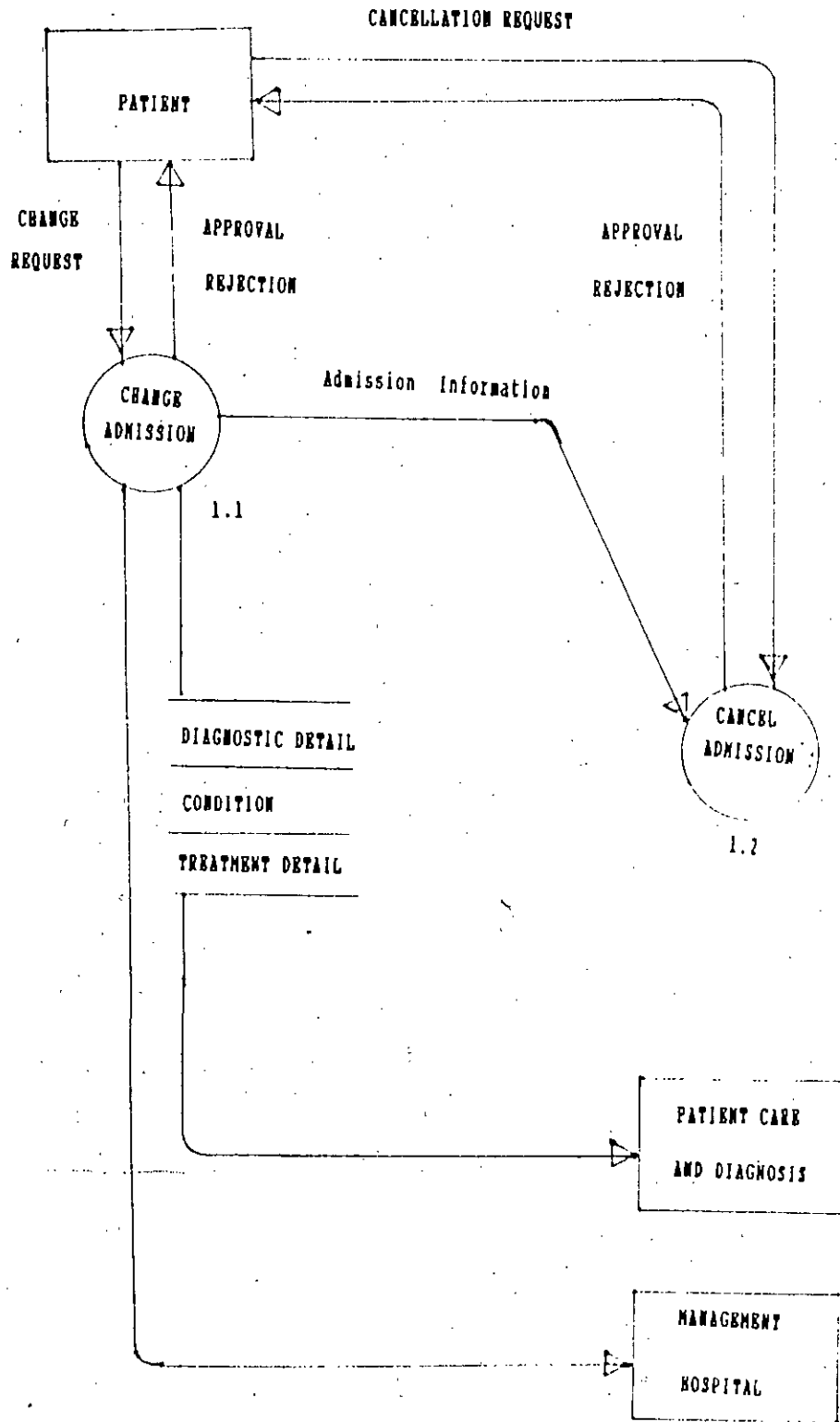


Fig-4
 Second level DFD of Process-1
 ADMISSION OPERATION

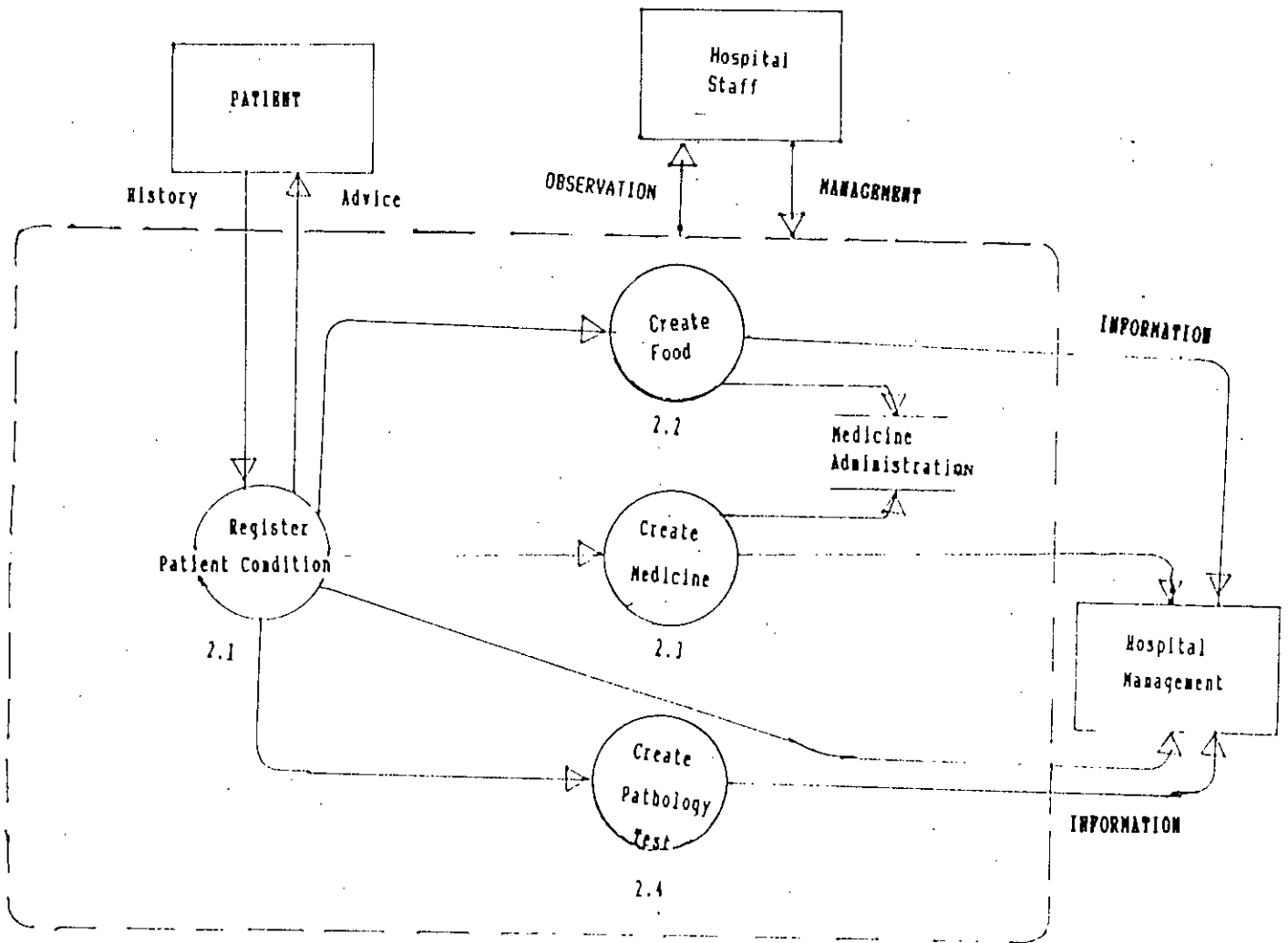


Fig-5

Second level DFD of process-2 Patient care & Medicine Administration.

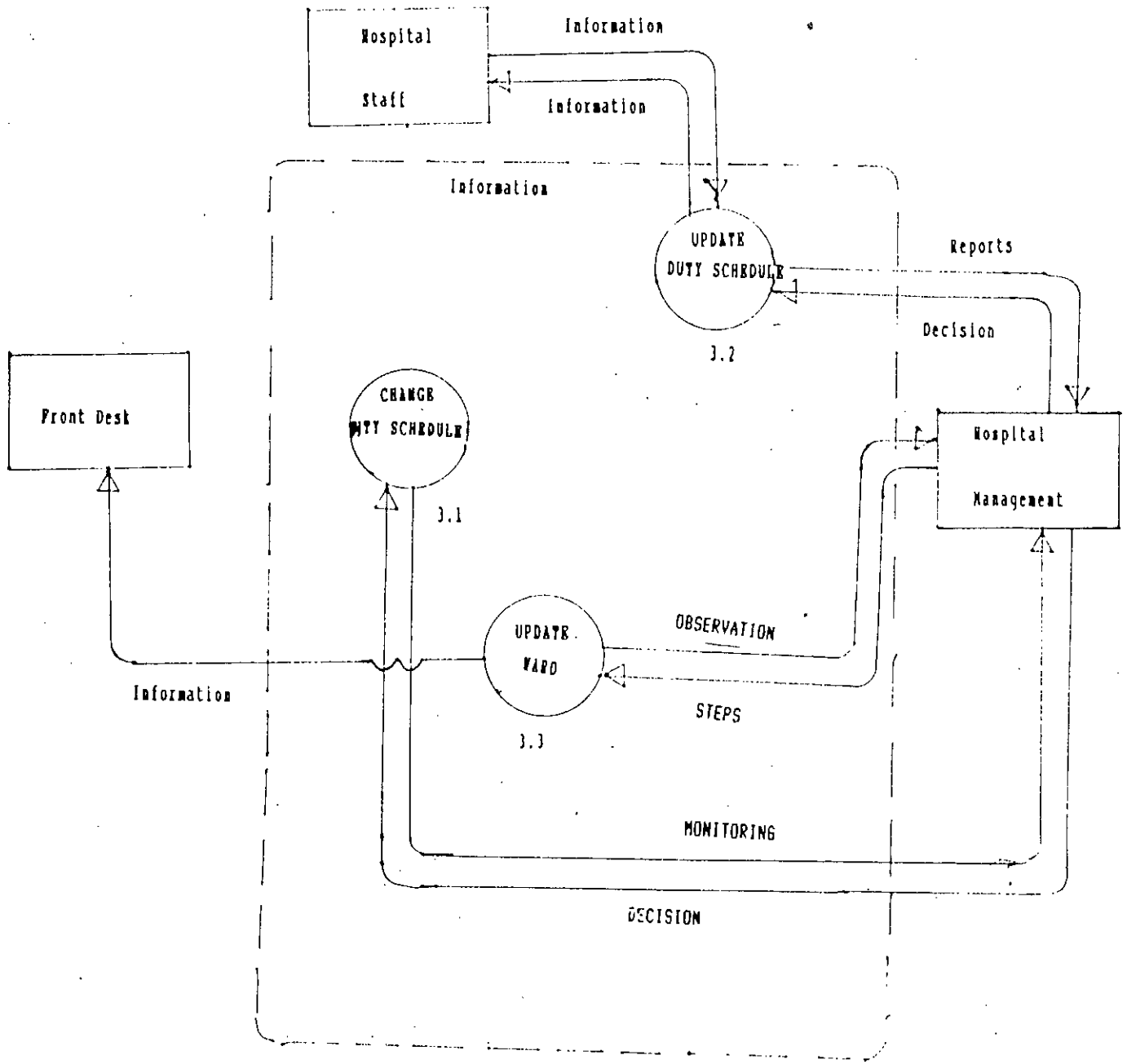


Fig-6 Second level DPD of process-3 Administrative Control.

4.2.3 Identification of Database Information

After the information requirements have been documented by the DFDs, the next step is to choose what data elements are to be included in the database. Since the data store from the DFDs represent a fine delayed data, they must be analyzed what elements are suitable for database storage.

There are 7 data stores from the DFDs

- a) Inpatient
- b) Ward
- c) Medicine
- d) Pathology
- e) General Condition
- f) Staff
- g) Food

In addition to there is another data store is required for archive purpose i.e. outpatient.

Two more dictionary data stores are proposed to facilitate coding of Pathological Samples and Disease Diagnosis.

4.3 Structural Analysis

At this point, the problem of representing all relevant aspects of the enterprise at a sufficient degree of detail to capture the database requirements is analyzed. The conceptual schema is defined by first analyzing the static properties of data.

Structurally each data store comprise several data element or attribute for constructing the whole store. Table-1 gives a list of structures of the elements of data on the basis of data stores previously identified.

In the medicine data store though the doses are not conventionally prescribed in form of structure shown. But this dose structure can easily derived from the prescription given by the doctors and easily be coded to fit into the database.

The data store Pathology Dictionary is basically a dictionary on the names on variety of tests advised for various pathological diagnostic purposes. This dictionary will make the Pathological information data store efficient by enabling the user to code the type of Pathological test and date entry also be easy and fast.

The data store Disease dictionary is for housing the codes of International Classification of Diseases. The codes are assigned by the World Health Organisation and are widely accepted to name a disease based on history, clinical findings and laboratory investigations. The dictionary will make the inpatient data store simple and easy retrievable. The implementation of these codes will also simplify the data entry as was the case with Pathology dictionary.

Table - 1

Analysis of Data Stores

Serial	Data Stores	Data Elements	Database	Comment
1	Patient Particular	Inpatient Number	Yes	generated by the system to avoid data inconsistency
		Name of Patient	Yes	
		Name of Patient gardian	Yes	
		Address of Patient	Yes	
		Age	Yes	
		Sex	Yes	
		Admission date	Yes	
		Contact Telephone	Yes	
2	Wards Particular	Reference	No	From where the patient has been referred
		Ward Number	Yes	generated by system to avoid data inconsistency
		Ward name	Yes	
		Number of bed	Yes	Specifics how many bed present in a Ward
		Telephone No	Yes	
		Date of Openning	Yes	Specifics date of Starting of the ward

Serial	Data Stores	Data Elements	Database	Comment
3	Condition	Condition code	yes	generated by the System
		Condition	Yes	Specifics particular of condition
		Time	Yes	Specifics time of observation
		Date	Yes	Specifics date of observation
4	Medicine Administration	Medicine code	Yes	generated by the system
		Name of Medicine	Yes	
		Dose Particular	Yes	Specifics designation of dose
		First dose	Yes	Time of first dose
		Second dose	Yes	Time of second dose
		Third dose	Yes	Time of third dose
		Fourth dose	Yes	Time of fourth dose
		Daywise dose	Yes	Specifics the case of daywise dose administration
		Special information	Yes	Specifics any special requirement for Medicine administration

Serial	Data Stores	Data Elements	Database	Comment
5	Pathological information	Path code	Yes	System generated
		Name of sample	Yes	
		Finding	Yes	Brief description of the test
		Comment	Yes	Specifics comment on pathological finding
6	Staff Particular	Staff No	Yes	System generated
		Name of staff	Yes	
		First level of qualification	Yes	Specifics qualification upto a Bachelors level
		Second level of qualification	Yes	Specifies qualification upto Master
		Third level of qualification	yes	specifics qualification upto P.hd level
		Address of Residence	Yes	
		Telephone Office	Yes	
		Telephone Residence	Yes	
		Number of Dependant	Yes	
		Basic Salary	Yes	

Serial	Data Stores	Data Elements	Database	Comment
		Date of Joining	Yes	
		Date of Birth	Yes	
		Designation	Yes	
7.	Food	Foodcode	Yes	System generated
		Type of Food	Yes	Description of food
		Quantity	Yes	Quantity to be served
		No of times	Yes	How many times to be serv
		Forbidden	Yes	Any food forbidden
		Remarks	Yes	Anything Special
8.	Out door Patient	Out Patient Numbers	Yes	System Generated
		Name	Yes	
		Age	Yes	
		Sex	Yes	
		Date Seen	Yes	
		Medicine-1	Yes	Prescribed Medicine number-1
		Medicine-2	Yes	Prescribed Medicine number-2
		Medicine-3	Yes	Prescribed Medicine number-3

Serial	Data Stores	Data Elements	Database	Comment
		Medicine-4	Yes	Prescribed Medicine number-4
		Medicine-5	Yes	Prescribed Medicine number-5
		Medicine-6	Yes	Prescribed Medicine number-6
		Comments	No	
9.	Dictionary Pathology			
		Sample Code	Yes	Sample Code for Patholo- cal Speci men.
		Description	Yes	Name of Sample
10.	Disease Dictionary			
		Disease Code	Yes	Code of Disease Given by WHO.
		Disease	Yes	Name of Disease.

4.3.1 Identification of Entity and Relationship

By analyzing the DFDs & data stores a list of entities and relationship is determined.

4.3.2 Drawing of ERDs

Figures 7 to 12 show the localized ERDs as a result of the identification of entity and relationship types. A one-to-one (1:1) between outpatient-admits as-inpatient. Patient-have-condition represent (1:n) means one patient can have many condition. In many-to-many relationship (M:N) one staff can work in many wards and a ward may be workplace of many staffs.

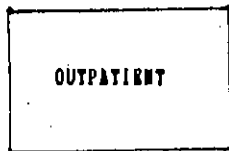
The localized ERDs are grouped together to form the normalized ERDs. Figure-13 is such a grouped ERD obtained from the localised ERDs of figures 7 to 12.

4.3.3 Identification of Attributes

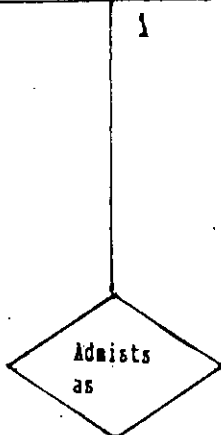
Attributes are the properties of an Entity. These attributes when chosen by itself can serve as a prime indicator and establish relationship with Entities. Thus the attributes can also identify each entity and relationship. The key or prime indicators were shown in figures 7 to 12 in the form of underlined attributes.

4.4 Behavioral Analysis

In this last stage of logical system design, the behaviors of each entity and relationship is described according to their own life histories. Which can be incorporated to develop a model using the Entity-Relationship Diagram.



Outpatient-no, Outpatient name, Age, Sex, date-attended, medicine-1, Medicine-2, Medicine-2, Medicine-3, Medicine-4, Medicine-5, Medicine-5, medicine-6, Comment



Outpatient-no, Inpatient-no



Inpatient-no, Inpatient name, gardian name, Age, Sex, Date admitted, Residence address, Telephone no, Remarks.

Fig-7
Localised ERDs For the MHIS



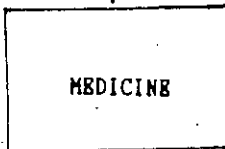
Inpatient-no., Inpatient name, gardian name, Age, Sex, Date admittted, Residence address, Telephone no, Remarks.

1



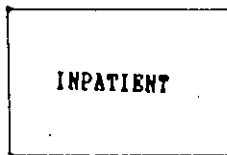
Inpatient-no., Medicine-code

N



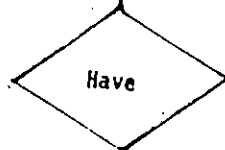
Medicine-code, Date-given, Time-given, Medicine-name, Dose-description, Dose-1, Dose-2, Dose-3, Dose-4, Dose-dawise, Time of administration, Food, Special-instruction

Flg-8
Localised ERDs For the MHIS



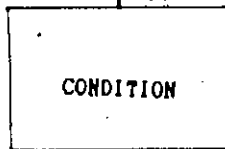
Inpatient-no., Inpatient name, gardian name, Age, Sex, Date admitted, Residence address, Telephone no, Remarks.

1



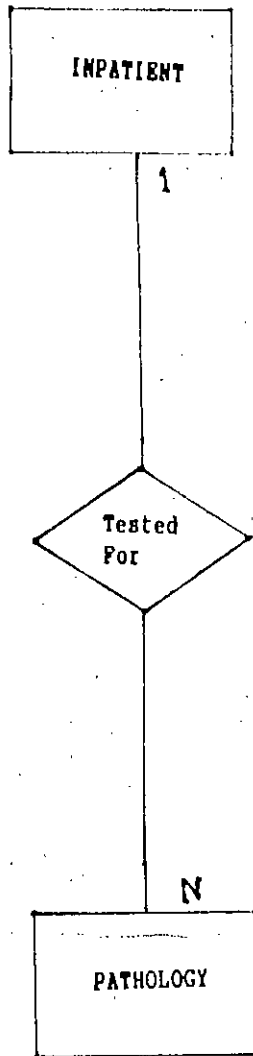
Inpatient-no., Condition-code

N



Condition-code. Date-observation, Time-observation, condition-name, Reading, Comment

Fig-9
Localised ERDs for the MHIS

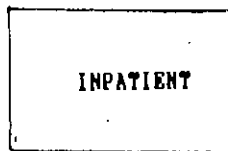


Inpatient-no, Inpatient name, gardian name, Age, Sex, Date admitted, Residence address, Telephone no, Remarks.

Inpatient-no, Pathology-code

Pathology-code, Date-examined, Time-examined, Sample, Finding, Comment

Fig-10
Localized ERDs for the MHIS



Inpatient-no., Inpatient name, gardian name, Age, Sex, Date admitted, Residence address, Telephone no, Remarks.

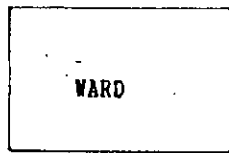


Inpatient-no., Ward -no., Bed-no



Ward-no., Ward-name, Speciality, Bed numbers, Telephone no, Date opened

Fig-11
Localised ERDs for the MHIS



Ward-no., Ward-name, Speciality, Bed numbers, Telephone no, Date opened

M



Ward-no., Staff-no

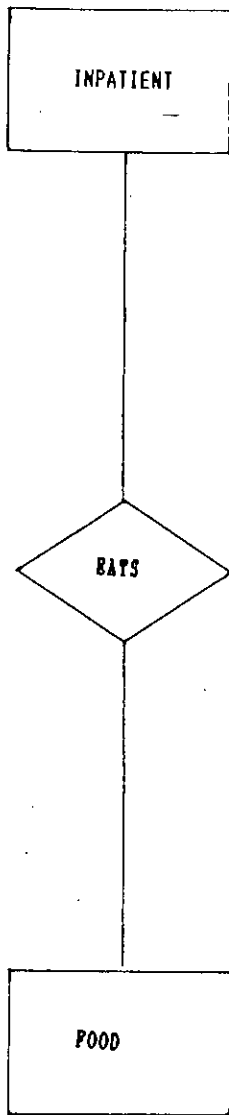
N



Staff-no., Staff-name, Fathers-name, Qualification -1, Qualification-2, Qualification-3, Experience, Residence-address, Telephone-office, Telephone-residence, Duty-starts, Duty-end, Date-joined, Birth-date, Disignationb, Remark

Fig-12

Localised ERDs for the MHIS



Inpatient-no., Inpatient name, gardian name, Age, Sex, Date admitted, Residence address, Telephone no, Remarks.

Inpatient-no., Foodcode

Foodcode. Type-of-Pood, Quantity, No-of-Times, Forbidden, Remarks.

Fig 12a.
Localised ERDs for the MHIS.

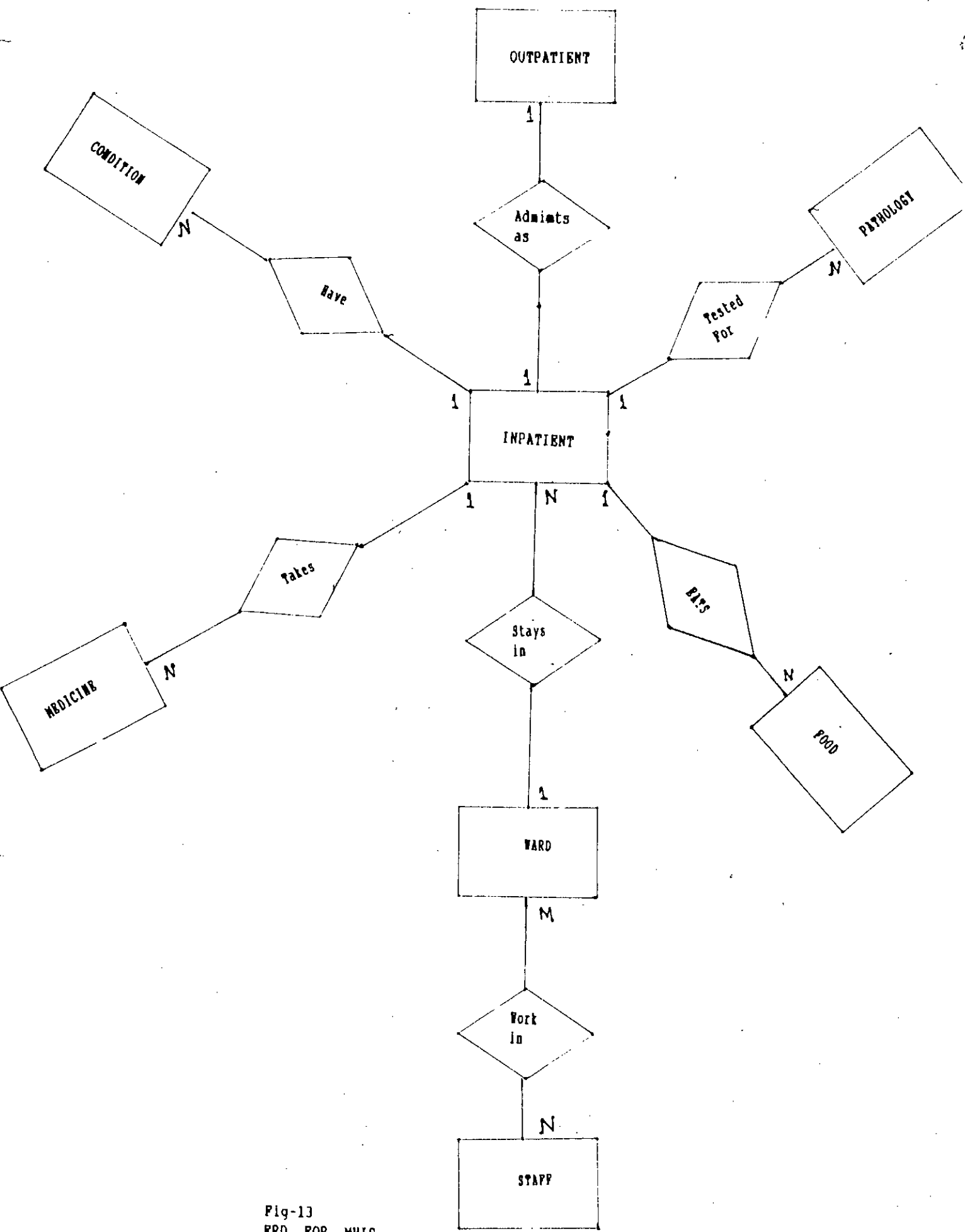


Fig-13
ERD FOR MHIS

4.4.1 Instantiation of Entities

The line span of day is chosen for instantiating the entities and relationship. Daily management of activities within the hospital is critical in a hospital is critical so it is desirable to describe the day to day behavior of the data.

4.4.2 Identification of User queries

User queries many differ with different instantiation level. These instantiation levels were shown in the diagrams of figures 14 & 15 but queries on the basis of this change of instantiation level were not considered in the implementation phase of the study.

The user queries are identified as a result of the different user forms at the first instantiation level. A comparison of those queries with those narrated in the requirement section satisfies hence fulfills the need.

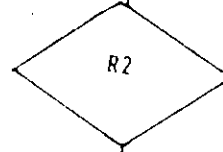
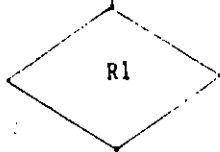
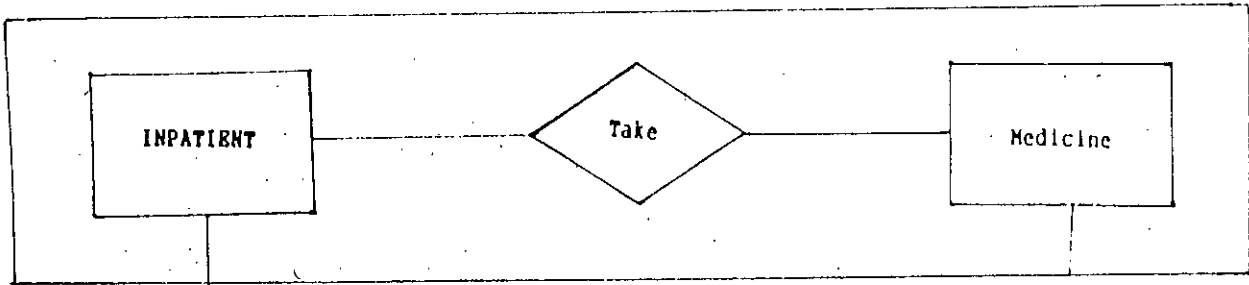
4.4.3 Development of ERDBs

Once a localized ERD is abstracted to its second instantiation level, Petri net graphs may be developed for each entity and relationship is an ERD. Result of this produces the ERBD (Entity Relationship Behavior Diagram).

Since the implementation phase was only restricted to the first instantiation level this part of work was not undertaken and may be a future course of work.

Analysis of the life History of Entities through their state is to be mode so that a nil state instance exists in order to keep the integrity of the database. Behavior description is another vital part of the ERBD's development process. In order to describe the behavior that exists for each entity and relationship sets, the state and transaction descriptions are defined. The identification of dynamic degrees to each entity and relationship provides an overview on how the data evolve over a period of time and its specification may be considered at the last. Events cause a change in the state of data elements described in relation to a specific activity within the enterprise. Analysis of these properties of the data, thus, ensures completeness and integrity of the database under the various application of the enterprise.

First Instantiation Level



Second Instantiation Level

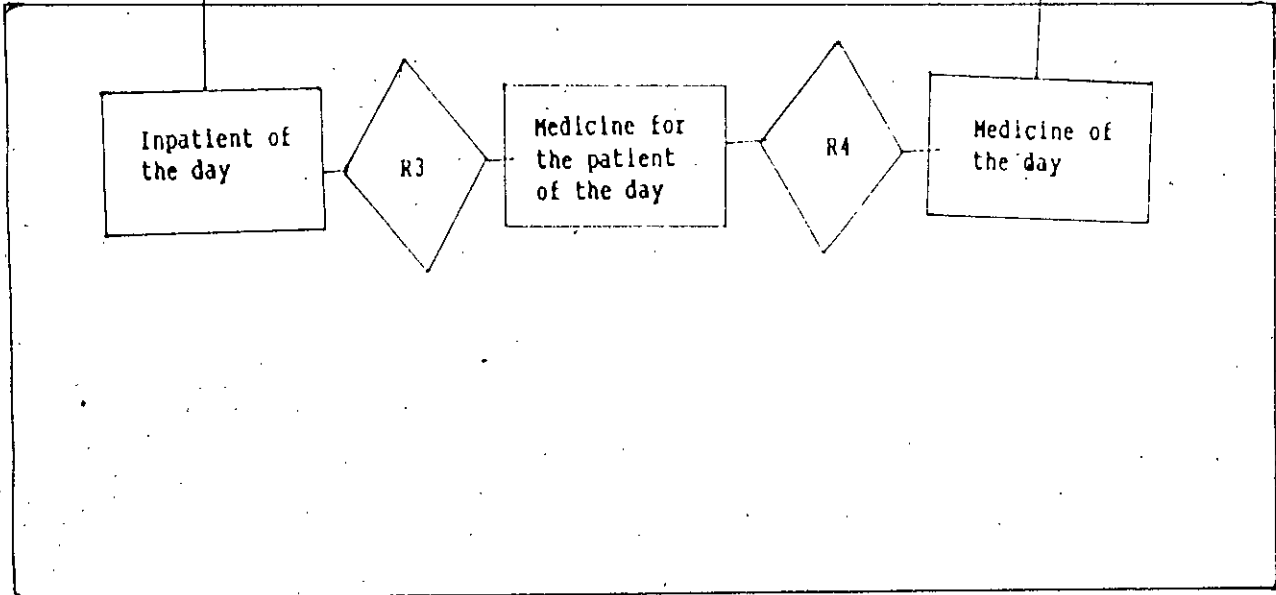


Fig - 14
ERD with two instantiation level
for ER Inpatient - Take - Medicine

First Instantiation Level

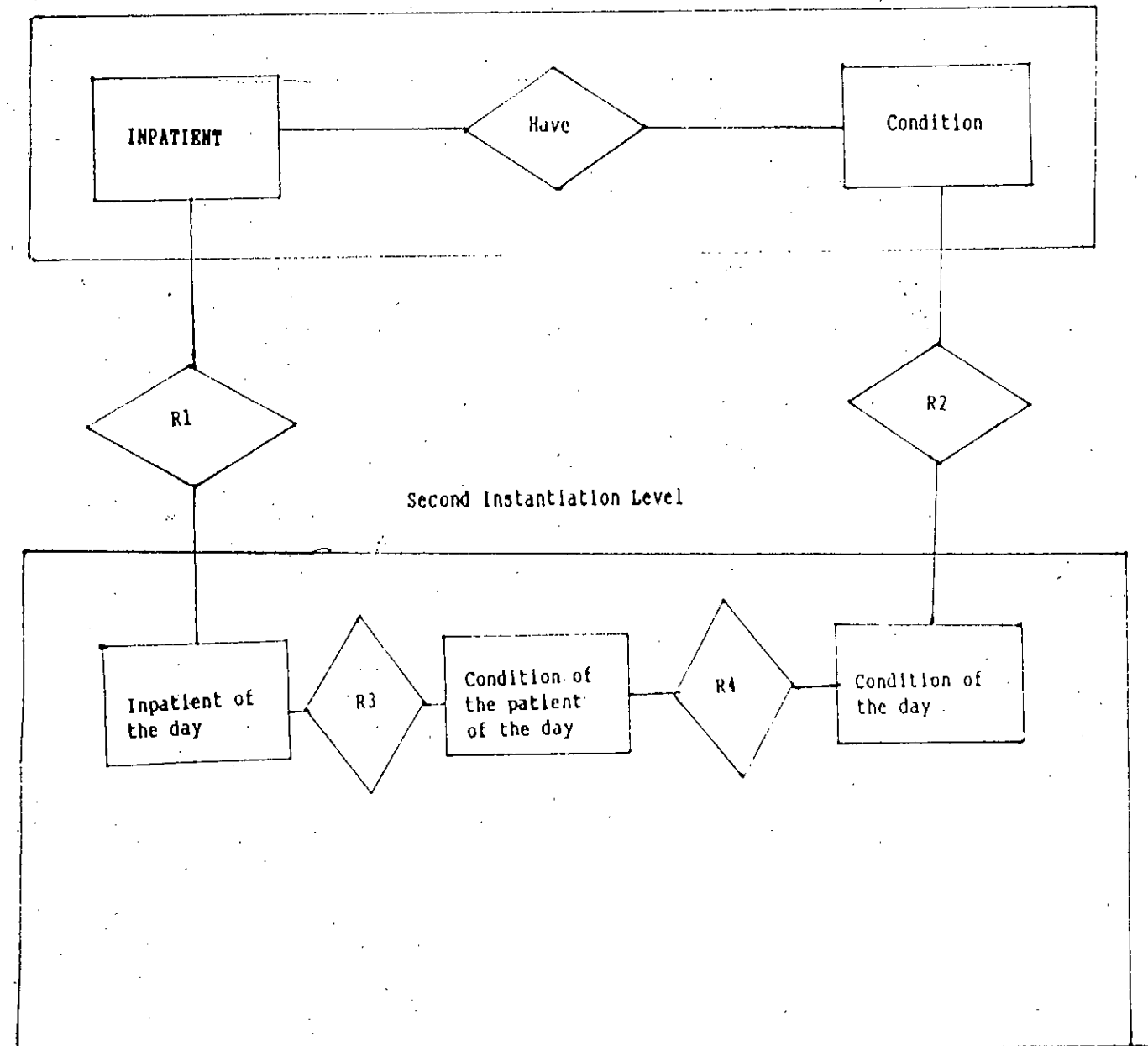


Fig - 15
ERD with two instantiation level
for ER Inpatient - Have - Medicine

4.5 Space Allocation for Data Stores

From the analysis presented above the data stores were identified. These datastores have several attributes as detailed in the table-1 in order to process the user queries. The attributes obtained may be kept in a database as per the allocated maximum length described in the table-2. The table also shows the type of data to be kept in that space.

Table - 2

Data Space Allocation

1. Data Store : Patient Particular

Data Element	Data type	Maximum length
Inpatient Number	Alphanumeric	6
Name of patient	Character	20
Guardian Name	Character	15
Address	Numeric	25
Age	Numeric	3
Sex	Logical	1
Admission date	Date	8
Contact Phone	Alphanumeric	6
Disease Code1	Alphanumeric	6
Disease Code2	Alphanumeric	6
Disease Code3	Alphanumeric	6
Disease Code4	Alphanumeric	6

Total (Maximum Length)		108

2. Data Store : Ward Particulars

Data Element	Data type	Maximum length
Ward No	Alphanumeric	2
Ward name	Character	10
Number of Bed	Numeric	3
Telephone	Alphanumeric	6
Opening date	Date	8

Total (Total Maximum Length)		29

3.Data Store : Condition

Data Element	Data type	Maximum length
Condition Code	Numeric	6
Condition	Character	20
Time	Numeric	4
Date Observation	Date	8

Total (Maximum length)		38

4.Data Store : Medicine Administration

Data Element	Data type	Maximum length
Medicine Code	Numeric	6
Dose particular	Character	10
First dose	Numeric	4
Second dose	Numeric	4
Third dose	Numeric	4
Fourth dose	Numeric	4
Daywise dose	Numeric	2
Special Information	Character	15

Total (Maximum length)		49

5.Data Store : Pathological Information

Data Element	Data type	Maximum length
Path Code	Numeric	6
Sample Code	Numeric	2
Finding	Character	30
Comment	Character	15

Total (Maximum length)		53

6. Data Store : Staff particular

Data Element	Data type	Maximum length
Staff no	Alphanumeric	3
Name of Staff	Character	10
First Qualification	Character	8
Second Qualification	Character	8
Third Qualification	Character	8
Address	Character	25
Phone Office	Numeric	6
Phone Res	Numeric	6
No of Dependent	Numeric	2
Basic pay	Numeric	6
Date of Join	Date	16
Date of Birth	Date	8
Designation	Character	15

Total (Maximum length)		121

7. Data Store Food

Food code	Alphanumeric	6
Type of Food	Character	15
Quantity	Character	8
Forbidden	Character	10
Remarks	Character	10

Total (Maximum length)		49

8. Data Store : <u>Out Patient Particular</u>		
Data Element	Data type	Maximum length
Outpatient Number	Alphanumeric	6
Name	Character	20
Age	Numeric	3
Sex	Logical	1
Date sear	Date	8
Medicine-1	Character	10
Medicine-2	Character	10
Medicine-3	Character	10
Medicine-4	Character	10
Medicine-5	Character	10
Medicine-6	Character	10
Total (Maximum Length)		98

In addition to these data stores there will be two more data store for using as dictionary of pathological Samples and Disease Classification. One of which may be designated as Data Store :Dictionary of pathological samples and the other one as Data Store : Disease Dictionary in accordance with the Disease Classification code given by the World Health Organisation.

9. Data Store <u>Dictionary Pathology</u>		
Data Element	Data type	Maximum length
Sample code	Alphanumeric	3
Sample Name	Character	15
Total (Maximum Length)		18

10. Data Store <u>Disease Dictionary</u>		
Data Element	Data type	Maximum length
Disease code	Alphanumeric	6
Name	Character	20
Total (Maximum Length)		26

CHAPTER – 5

PHYSICAL SYSTEM DESIGN

5.1 Hardware Configuration

The MHIS system is designed specially for IBM microcomputers and clones (IBM PC compatibles) that run under the MS-DOS (Microsoft-Disk Operating System). The system ideally needs a microbase Local Area Network (LAN) to connect the front desk operator, ward and administrative office work station to the file server or the super station. However the super station may alone work without a network, with the limitation of one terminal and may include the following minimum peripheral devices.

- a) CPU with at least 640 KB RAM
- b) 20 x 80 character monochrome display
- c) Keyboard
- d) Two disk drive (of which one must be hard disk)
- e) 80 or 132 character printer

The configuration may be expanded to increase the memory size or to use more hard-disks. As data increases in a given time period, it will necessitate the organization to increase also the main memory and storage devices.

In case of a network the workstation should have the following minimum configuration.

- a) CPU with at least 256 KB RAM
- b) 24 x 80 character display
- c) Keyboard
- d) One Floppy Drive

Color monitors can also be used for both the cases with a color adapter in the CPU unit.

5.2 Language Implementation

Initially it was intended to use SQL as implementation language. Later dBase-IV was chosen for several reasons. dBase is designed for application areas in data processing. It is well suited to data processing applications, since it contains such powerful built in functional elements as data entry features, table search function and sort facilities. These features of dBase are de-

signed to aid the programmer in organizing, accessing, updating, reordering and reporting data in file, dBase also provides extensive facilities for file handling whose organizations are either indexed or random. File manipulation functions and features found in data processing application which is exactly in the nature of the MHIS system.

The dBase used for our purpose is the Ashton-Tate dBase version IV that runs under MSDOS version 2.0 or greater, or Compaq DOS version 3.31. This version of dBase requires a harddisk of which 3.5 MB must be free. The minimum memory requirement is 640 KB RAM.

- a) dBase is validated at high level, meaning more standard dBase features, including indexed files and dynamically called subroutines and available for program use.
- b) dBase program with the help of clipper can be converted to executable programs.
- c) dBase support screen handling facilities and Interactive system.

5.3 Collection of Data

Data generated in each area of the system under consideration is related to the activities concerned and has its own shape and format. Therefore a throughout coding of data as per information system requirement at the field level may cause error. Hence data forms developed already developed in different areas is coded later and reshaped in accordance to the input format requirement as described in section 5.4. Some of the developed data used by different areas are attached as Appendix - A.

5.4 Input / Output Design

The three dialogue designs menus, question & answer and form filling are used in designing the screen Layout. The menus enable the user to select the function to be performed by the system, such as patient care activities in the ward, administrative queries, quit from the program, query processing in SQL and a log off totally from the dBase program. In the form filling, the system ask the user to fill-in data that are processing. A list of screen layouts have been attached.

The report formats are derived from the user requirements. These are formatted in such a way that these satisfy the users specifications and how these will appear on paper and screen. Each report is distinguished from the other by an appropriate title because some reports contain the same information but differ from how the user views them. Please refer to the MHIS procedure manual for the use of different report formats.

Figure-16 welcomes the user and would ask for an input from 1-5 for Patient admission, Inhouse patient care, Administrative control, Outpatient data entry and Database handling in SQL. Input no-6 will be used for exit to DOS, the operating system.

Figure-17 would be resulted upon selection of no-1 from figure-16 and will ask the user to select 1 to 4 for Ward Information, Bed occupancy, returning back to previous screen and Exit respectively.

Figure-18 is the result of selection of no-2 from figure-16. This input format has seven options. 1 to 3 is for information regarding General condition, Pathological and Medicine Administration respectively. 4 to 6 is for new data entry for General condition, Pathological and Medicine administration. No-7 is for returning to previous page i.e to figure-16.

Figure 19 is the selection no-3 from the figure 16 and allows the user to process query on particular employee's duty by no.1, or ward duties by no.2, as Bed Occupancy by no.3 & for changing an Duty Schedule by No.4, or Ward data by No.5, on personal data for previous page no.7

Figure-20 is the input format for Impatient data entry and the menu will be entered through the selection of no.2 of figure-17, which will first report about the bed position of a particular ward and will take the user to this format upon selection of a vacant bed.

Figure-20 will result from the selection of no.4 from figure 18 and allows the user to enter data on different fields related to condition.

If no-5 of figure 18 is selected Figure-21 will be the result and the format will allow the user to input data on several parameters on pathology.

Figure-23 is for Medicine Administration data entry & is a result of no-6 selection from figure-18.

Outpatient Data Entry form is presented in figure-24 and is a result of selection of no-4 from figure-16.

WELCOME TO
HOSPITAL INFORMATION SYSTEM

Select

- 1 For Patient Admission
- 2 For Inhouse Patient Care
- 3 For Administrative Control
- 4 For Out Patient Data Entry
- 5 For Database Handling in SQL
- 6 For Exit to DOS

Please Enter Your Choice 0

Fig - 16
The input format design for the opening Menu
of the Hospital Information System.

HOSPITAL INFORMATION _ PATIENT ADMISSION

Select:

- 1 For Ward Information
- 2 For Bed Occupancy in a Particular Ward
- 3 For Previous Screen
- 4 For Exit

Please Enter Your Chioce 0

Fig - 17

The input format design for the Patient Admission of the Hospital Information System.

Patient Care Activities ----- Hospital Information System

Select

- 1 For General Condition Information of a Patient
- 2 For Pathological Information of a Patient
- 3 For Medicine Administration of a Patient
- 4 For Adding New General Condition Data
- 5 For Adding Pathological Test Information
- 6 For Adding Prescribed Medicine Administration Schedule
- 7 For Previous Page

Please Enter Your Choice : 0

Fig - 18
The input format design for the Patient Care activities the Hospital Information System.

Administrative Control ----- Hospital Information System

Select :

- 1 For Query on Individual's Duty
- 2 For Query on Ward Duties
- 3 For Query on Bed Occupancy of a Ward
- 4 For Changing Duty Schedule
- 5 For Changes in Ward Data
- 6 For Changing/Adding Personnel Data
- 7 For Previous Page

Please Enter Your Choice : 0

Fig - 19
The input format design for the Administrative
Control of the Hospital Information System.

In_patient Data Entry ---- Hospital Information System

The Alloted Bed Number is 2 and the Ward Number is 01
Please Note the Patient Number 17

Out Patient Number :

Patient Name:

Gardian Name:

Age:

Sex(M/F):

Admission: / /

Address:

Residence Telephone:

Patient Referral:

Remark:

Is the Entered Data Correct ? If please press Y ,

Otherwise press N :

Fig - 20

The input format design for the Inpatient Data
Entry of the Hospital Information System.

Adding General Condition Data --- Hospital Information

Enter Ward Number : 02 Enter Bed Number : 32
The Number of the Patient is :

Please Enter Motion Appearance :
 Temperature :
Diastolic Blood Pressure :
Systolic Blood Pressure :
 Heart Bit :
Special Findings :

Comments or Food restrictions :

 Date Remarks :
 Time :

If the data entered above is correct please press Y
otherwise press N :

Fig - 21
The input format design for the General Condition Data Entry of the Hospital Information System.

Adding Pathological Information Data --- Hospital Information

Enter Ward Number : 02 Enter Bed Number : 32

The Number of the Patient is :

Sample Code :

Findings :

Comments :

Date :

Remarks :

Time :

If the data entered above is correct please press Y
therwise press N :

Fig - 22

The input format design for the Pathological
Data Entry of the Hospital Information System.

Outpatient Data Entry -----Hospital Information System

Enter the data given below :

Outpatient Number :
Name :
Age :
Date :
Medicine One :
Medicine Two :
Medicine Three :
Medicine Four :
Medicine Five :
Medicine Six :

Fig - 24
The input format design for the Out-patient
Data Entry of the Hospital Information System.

Figure-25 is a pure reporting format on ward information and will be generated through selection of no-1 from figure-17.

Figure-26 is in a mixed format this will report about the vacant beds of a particular ward and will also allow the user to select bed no for particular patient. This will be entered through the selection of no-2 of figure-17.

Figures-27, 28 and 29 are purely report formats and be accessed through the selection of nos-1, 2 & 3 of figure-18. The figure-27 presents several condition of particular patients identified by bed no and ward nos. On the basis of similar identification the figures-28 & 29 reports pathological & medicine information respective.

This query Provide Information on Ward number, --- Hospital Information
Name of Ward and Total number of Beds

WARD NO	NAME OF THE WARD	TOTAL BEDS	WARD NO	NAME OF THE WARD	TOTAL BEDS
01	Emergency	12	02	Trt Centre	75
03	Metabolic	69	04	Intensive	40
05	Zinc Study	40			

Press any key to continue...

Fig - 25

The output format / report design for the Ward information on beds & speciality of the Hospital Information System.

This query displays vaccant beds of a ward---Hospital Information

Please Enter Ward Number 01 Total Number of beds 12

Beds lying vaccant are:

1 2 3 4 5 6 7 8 9 10 11 12

bed number for Patient's admission or 0 for previous page

Fig - 26

The output format / report design for the
Vaccant Beds of a Ward of the Hospital Informa-
tion System.

---Patient's General Condition ----- Hospital Information

Ward Number : 02

Bed Number : 33

The Number of the Patient is : 000002.

DATE	TIME	STOOL OBSRV	TEMP CEL	BP DYS	BP SYS	HRT BIT	COMMENT	REMARK
7/08/88	1200	Watery	98	90	110	72	Diarrhoea	
7/06/88	1300	Watery	99	95	115	72	Diarrhoea	
8/07/88	1400	Normal	100	100	120	72	Fever	

any key to continue...

Fig - 27
The output format / report design for the
Patient's General Condition Query of the Hospi-
tal Information System.

Patient's Pathological Findings ----- Hospital Information

Enter Ward Number : 02 Enter Bed Number : 33

The Number of the Patient is : 000002

DATE	TIME	SAMPLE	COMMENT	FINDING
6/07/88	1000	Blood m/e	Malaria	Malarial Parasite
6/07/88	1100	Stool m/e	Infection	Pus cell present

any key to continue...

Fig - 28

The output format / report design for the Query on the Pathological Findings of the Hospital Information System.

Patient's Medicine Administration ----- Hospital Information

Enter Ward Number : 02

Enter Bed Number : 31

The Number of the Patient is : 000001

DATE	TIME	MEDICINE NAME	DOSE I	DOSE II	DOSE III	DOSE IV	OTHER INSTRUCTIONS
4/05/88	1000	Ampicillin	0600	1200	1800	2400	For 7 days
2/01/88	1200	Phenobarbitone	0800	1400	2200		5 days

any key to continue...

Fig - 29
The output format / report design for the Query
on the Medicine Administration of the Hospital
Information System.

5.5 File Design

The MHIS is basically a file management system. The entities and relationships are translated in dBase files in such a way that one entity or relationship corresponds to one file and the attributes of the entity or relationship correspond to one field in the file. Key fields are used during query processing.

CHAPTER - 6

BENEFIT ANALYSIS

6.1 Cost of System

In order to install the system in a hospital the following requirements may be proposed and cost of each item was shown against those on the basis of present market value.

A) Cost of hardware: The equipment, devices and their accessories.

i) One file-server with 2 floppy drive 2 harddisk, 640 KB RAM & Monochrome Monitor.	Tk 90,000.00
ii) 8 Workstations with 2 floppy drive, Mono Monitor, 640 KB RAM @ Tk 40,000.00 each	Tk 3,20,000.00
iii) 4 Printers @ Tk 20,000.00 each	Tk 80,000.00
iv) Local Area Network for 8 stations	Tk 1,00,000.00
<hr/>	
Total Hardware Cost	Tk 5,90,000.00

B) Software cost may be stated as follows:

i) Cost of the software Package	Tk 1,00,000.00
ii) Modification, refining to make it compatible with the existing system	Tk 1,00,000.00
<hr/>	
Total Software Cost	Tk 2,00,000.00

C) Cost of other items like ribbons, diskettes, paper and other consumable utilities L.S Tk 10,000.00

Total cost of all the above items:

Against A:Hardware	Tk 5,90,000.00
Against B:Software	Tk 2,00,000.00
Against C:Utilities	Tk 10,000.00

Grand Total	Tk 8,00,000.00

In addition to the above categories of requirements, there will be other requirements on office furniture like desks, chairs, lockers etc. and personnel to bring the system under operation. Cost involvement in these items is highly flexible and depends on the organization's policy.

6.2 Cost Benefit Analysis

As per the ratio of indoor patient and doctor the standard has been found as 20:1. The ratio for the patient and nurses the standard is 10:1. But the ratio drops significantly for the case of intensive & emergency wards and others depending on the nature of patient they manage. It is expected that upon implementation of the system the span of control for the doctors would increase significantly as they would be able to set all necessary information regarding patient's condition, pathology, medicine, history etc. by sitting on a terminal desk. Almost similar is the case with the nurses they need not to handle a huge number of files to know about medicine administration timing or food requirements of patient etc. However it would be necessary for them to attend patient to patient for condition monitoring and application of medicine to them. Which reveals that the span of control for the doctors would be increased more significantly than that of the nurses and it is expected to be more than double. However for the nurses the expectation is just double.

Thus a three hundred bedded hospital will require 15 doctors and 30 nurses for its smooth discharge of services to the patient. Upon the implementation of the system the span of control and the efficiency of the doctors & nurses working in the hospital would be increased so it is expected that the requirement of the doctors and nurses would be 7 and 15 respectively for the same hospital. The system will also increase the efficiency of the front desk people or the hospital receptionist and the Administrative Officer or Office Assistant as applicable. But they would require a little training on the system and it is assumed that these two things will compensate each other.

The information system if implemented will also save some capital investment because there will be a little requirement of file cabinets or racks for file placing or record keeping. Saving of paper works will be more significant. The consumption of stationery like paper, pads, file cover etc will drop sharply and projection estimated to drop to one third i.e the system will reduce it to a degree of two third, however some other consumables like printer paper, ribbon, diskette and diskette container will increase the stationery cost and ultimate drop may be estimated to half of the cost of the stationery requirement without the system. The consumption of the electricity will be increased. Since the computers do not consume much electrical power so this will not endanger its implementation on the ground of cost benefit.

The implementation of the information system will benefit the other area of the hospital as well, like supply of uniform, overall report preparation on hospital, personnel information etc. But saving due to these will not be much in comparison to the factors stated above and may be neglected.

The cost involvement of the other areas of the hospital, not mentioned above have been assumed to be static and not considered in the cost figures stated below :

The hospital is assumed to have six wards, a management office and a front desk totaling eight location.

6.2.1 One year basis costing without system.

a) Fixed cost	Total
i) 3 file cabinets for each location i,e 24 file Cabinets @ TK 4000.00	TK 96000.00

Assuming 10% straight line depreciation i,e a book value of zero after ten years

The Fixed cost for one year will be	TK 9600.00
-------------------------------------	------------

b) Variable Cost

I) Salary for 15 doctors @TK 12000.00 per month	TK 180000.00
---	--------------

II) Salary for 30 nurses @TK 5000.00 per month	TK 150000.00
--	--------------

III) Cost of stationery @TK 4000.00 (1.s) per location	TK 24000.00
--	-------------

Total for one month =	Tk 3,54,000.00
-----------------------	----------------

For One year	Tk42,48,000.00
--------------	----------------

IV) Cost of maintenance of capital investment @ 2% Tk2,000.00

Total variable Cost for One year TK 42,50,000.00

c) Total Operating Cost(One Year)

Fixed Cost + Variable Cost
10000.00 + 42,50,000.00= TK 42,60,000.00

6.2.2 One year basis Costing with the system.

a) Fixed Cost Calculation

Category A

i) Furniture
One File Cabinet at each location TK 32,000.00
@TK4000.00

Sub Total TK 32,000.00

Category B

i)One super station or File server with 2 HD & 2 FDD TK 90,000.00

ii) 8 work station with 2 FDD @ Tk 40,000.00 TK 3,20,000.00

iii) One Local Area Network TK 1,00,000.00

IV) Four Printers @ TK 20,000.00 Tk 80,000.00

V) Software Tk 1,00,000.00

Sub-total Tk 6,90,000.00

Assuming 10% Straight line depreciation or Category A
 i.e Zero book value after ten years
 the fixed complement because TK 3,200.00

Assuming 16.66 Straight line depreciation or Category B
 i.e Zero book rating after six year
 the fixed cost component because TK 98,294.00

 Total fixed Cost for 1 year TK 1,01,494.00

b) Variable Cost

i) Salary for 7 doctors TK 84,000.00
 @TK 12000.00 per month

ii) Salary for 15 nurses TK 75,000.00
 @TK 5000 per month

iii) Salary for 1 system Coordinator / supervisor TK 15,000.00
 @TK 15000 per month

iv) Salary for 1 Asstt. System Coordinator TK 10,000.00
 @TK 10000 per month

v) Salary for 4 Data TK 4,000.00

vi) Cost of Stationery TK 12,000.00
 @TK 1500.00 (L.S) per location per month

vii) Power Consumption Tk 542.00
 7 location with 200 watts with average use of 8 hours (11200 watts per day) 1 location with 300 watts with 12 hours average use (2700 watts per day) for 1 month with 417 KWH @ Tk 1.30 per KWH

 Total for 1 month TK 2,00,542.00

I) For One year Tk 24,06,505.00

II) cost of Maintenance
on category A of Capital Tk 640.00

III) Cost of Maintenance on
Category B of capital
investment & Software
maintenance @12% Tk 82,800.00

Total variable cost Tk 24,89,945.00

c) Operating Cost(One Year)

Fixed cost + Variable cost
101494.00+2489945.00= Tk 25,91,439.00

6.2.3 Comment on cost Analysis

The above analysis indicates the cost Component of the area involved in the Operation of the hospital without the system reflects a figure of TK 42,60,000.00 where as if the information system is implemented it is expected to come down to a figure of TK 25,51,439.00 which mean that a saving of TK 16,68,000.00 may be expected. Thus it may be opined that the system is financially viable and may be confidently recommended for the purpose it is prepared.

6.3 General consideration

In with the implementation of the information system the hospital will enter into the era of computerization. The system will ensure prompt and efficient management of the hospital. The patients will receive their due care and treatment. Information and query processing on any available topic will be almost without delay. The system will also render support for incorporating all other activities of hospital with the system as a part of future development. Above all it can be said the system will improve the quality of service and efficiency as a whole.

CHAPTER - 7

IMPLEMENTATION

7.1 Program Coding

The Information system was Intended to Implement In SQL/DS (Structured Query Language/Data System) but a suitable micro based system (e.g. Oracle) was not available and Interactive program package development was not possible so the decision of switching to dBase-IV for program writing was taken with due consent from the advisor. In the program development Instantiation of the database and Its dynamic behavior of EER model was not considered and the program was restricted to a static model behavior. However the added features of the dBase-IV's to support SQL was used. As such all the files were created in SQL mode thus under a SQL database. With the additive features of the dBase these files can be effectively handled by the dBase program itself but cannot be restructured as dBase file. Since the files are under a database of SQL named DBHOSP. The CONFIG.DB of the DbASE-IV was accordingly configured through this DBHOSP path so that it gets all the files in the search route. Updating or adding (BROWSE) new data to the files are also possible with a dBase environment. But this may produce data inconsistency and the user was warned accordingly in the procedure manual.

For modification of file/table structures, adding and creating new file/table SQL environment is to be used. In case of restructuring previous table's different fields may be copied to new table's fields. Or the newly created Table may be started afresh. Old and unused tables may be dropped later.

7.1.1 Consideration

The main consideration of the program development was the interactive nature of the system. Though the system supports almost all day to day queries but accommodation of all possible queries in interactive nature was not possible. However other queries can easily be handled by SQL because the tables were created in SQL environment under a database name of DBHOSP. In order to do that an user is to know the SQL in dBase-IV syntax which differs a little from the SQL/DS operable in IBM S-370 mainframes.

7.1.2 Program Description

The program is comprised of several modules. Each module starts as procedure subsequently with a specific module name and ends as return as suggested by dBase programming requirement. The first procedure pre-initializes the system to become compatible for the subsequent task of the program. Each program module is sequentially named under a parent name qry. Again these modules were sub-moduled keeping the parenthood name of the previous module with an appended additional digit for its own identity. These modules as well starts as procedure and ends as return. Each module is demarked by a double line in the program list-

ing. The program listing also have comments line along with the program lines for identification purpose of the module.

7.2 Procedure Manual

The program is designed to support three main operations of Hospital's activities. Those are (a) Front Desk services (b) Ward activities (c) Administrative Control.

Front desk operation is meant for patient admission and discharge. Ward activities refer to patient care. Patient's condition monitoring, Pathological report handling and administration of drugs are covered in this operation. Administrative activities involve overall management of the hospital in question. It helps in maintaining duty schedule as assigned to different staff members, bed capacities in different wards and assigning duty places to different staff members.

The opening menu allows the user to perform any one of the above three options by choosing 1 to 3 or the user can quit from the program and either process queries in SQL if he or she has an exposure to SQL in dBase or can quit to DOS by selecting 5 or 6 respectively. The No-4 selection of the option menu is used for entering data of the outpatients for archive purpose and usable for query processing with SQL.

7.2.1 Front Desk Operation

The user is to select No-1 from the opening menu to enter into this part of the program. This part of program allows the user to admit, discharge or reallocate the bed in the hospital. Select no-1 and the program will show you the ward information which includes Number of ward, Name of ward and the total number of beds in that particular ward.

7.2.1.1 Admission

Check the eligibility of the patient for admission of the patient. On fulfillment of the criteria of admission by the patient select No-1 of the opening menu. Which will displays the listing of the wards, ward no and the bed capacity. From this screen enter the selected ward no. On the basis of the ward no entered the screen will show the vacant beds of the ward and for admission enter the bed no of a vacant bed and the system will ask for the data of the newly admitted patient and enter it carefully and the system will enquire about the data entered in screen is correct or not if correct press Y and the system will store it in the database.

If there is no bed left vacant enter 0 the system will go back to ward information menu and another ward no may be selected to continue the admission procedure. If no bed are available in the subsequently selected ward no option do the same as before and select another ward if suitable and after doing all these exercise if a bed is still not available do the needful as define by the hospital's regulation.

7.2.1.2 Discharge

For discharging a patient select No-2 from the front desk operation menu and the system will ask the user to enter the word No. and bed No. of the patient. If entered the system will delete the patient particular from the database and report on medicine taken by the patient pathological test performed would be produced.

7.2.1.3 Change of bed

Select No-3 for change of bed occupied by a particular patient. The system will ask for the patient's ward no. and bed no. After answering to this requirement the system will show a ward listing and upon selection of the ward no. the system will display the vacant bed. On entering a vacant bed no the task would be over. If there is no vacant bed responded, follow the procedure as detailed in admission.

7.2.2 Ward Activities

Selection of No-2 from the main menu pulls user to this operation. This menu allows the user to enquire about patient care activities condition, medicine administration and pathological finding by selecting 1,2 and 3 respective by.

7.2.2.1 Patient General Condition

Select No-1 from the Ward Activities menu (obtained by selecting 1 from the main menu). It will ask for the ward No. and bed No. and enter those accordingly and the system will display the general condition data of that particular patient.

7.2.2.2 Patient Medicine

Select No-2 from the ward activities. The system then will ask for the bed no. and ward no. and on receipt of these requirement the system will display the list of medicine Administered with dose and time.

7.2.2.3 Patient Pathology

Select No-3 from ward activities and as before the system will ask for ward no. and bed no. If you enter those the system will display the pathological information of the patient.

7.2.2.4 Data Entry for General Condition

Select No-4 from the ward activities. Enter bed no. and ward no. and the system will ask for general condition data. On completion of the data entry the system will ask whether the user wants to add data to database or not. If Y is pressed the system will take the user to the ward activities.

7.2.2.5 Data Entry for Medicine

Select No-5 from the ward activities and on receipt of ward No. and bed no. Several entry parameters will be prompted and data may be entered against those. The system will ask the user whether the data entered is correct or not. If he agrees and press Y the system will put the entered data to its database.

7.2.2.6 Data Entry for Pathology

Select No-6 from ward activity for pathological data Entry. The system will ask for bed no. and ward no. as usual. On entering these the system will ask the user to check for correct entry of data and ask the user to press Y if found O.K. Then the system will add these data to database.

7.2.2.7 Returning back to Opening and Exit

Select No-7 to do this. The system will take you to opening menu from where it is possible to exit from the running program.

7.3 Program Listing

Program listing has a great role to play during maintenance of the system in due course of time or whenever required. Without the listing of program codes the future development of the system is extremely difficult.

The list of the program is given in Appendix - B.

CHAPTER – 8

CONCLUSIONS

8.1 Discussion and Conclusions

A practical step-by-step methodology for the design of an information system using the extended entity relationship model is shown. Extensions of the entity-relationship to model behavioral properties of data are discussed in section 2.2.

All these methods used the interaction-oriented approach wherein the interaction between the application and the environment is described as well as the causes of changes in the application. Although these methods used the same concepts of operations, events and event synchronization method is suitably adapted because it can be integrated with the E-R conceptual model. The model developed for the hospital information system in a way that the analysis of the net reveals important information about the structural and dynamic behavior of the hospital information system.

The process of behavior modeling leads to the development of user queries and data formats which are used to assist the doctors and managers in hospital management.

The design process is also of interest since it offers a guide to the design of the databases and their modifications are induced from external events. It introduces in a simple way the notion of event that is commonly used in the literature but seldom clearly defined. Analysis of the event ensures the completeness and integrity of the database under various applications of the enterprise. The methodology has been illustrated with a simple database design problem, showing each design step in detail.

As a result, the facts of the real world which are of interest to the enterprise are considered from both static and dynamic points of view. The perception of data of the user is reflected in a natural way in the design of the MHIS architecture and also in the design of the programs.

The implementation plan is carefully considered so that the system can be run and modified in any microcomputer machine. Thus, the language needs to be highly, portable and easily modified and maintained by other programmers.

The system is highly interactive in nature so that the design of input and output should give ease of use to the operator.

8.2 Recommendations for Future Works

The MHIS system is strongly oriented towards simple inquiry and this is also a limit to its usefulness. Because of the incomplete knowledge of all the facts to be stored, the organization of those facts in the database according to the ER model means that they can be added later on according to a predetermined priority, if required. This is an advantage over traditional approaches.

Additional functions can be added, i.e. accounting, housekeeping, personnel & medicine stores as the present MHIS has included only limited operations of the hospital. The MHIS system satisfies only a small portion of the complete hospital organization thus, it is desirable to add other operations so that the users can benefit more from this information system.

The overall performance of the MHIS can be evaluated in the future in order to determine the efficiency of the system in terms of storage and memory allocations and response time of each transaction. A review and evaluation can help the person in charge of maintenance to improve the MHIS system.

An element of time, e.g. hours or minutes, can be incorporated into the system when observations are made to accommodate many functions in one day. A day as the smallest unit of time can hinder the doctor's decision amidst a long history of the patient which may have several variations and currently may not be in use.

APPENDIX – A

DATA COLLECTION FORMS

Courtesy: Laboratory Archive Unit, ICDDR,B
Thanks to Mr. Emarat Hossain.



ICDDR.B

Diarrhoeal Disease Treatment Centre Patient Record

Centre: Dhaka Matlab Teknaf

Study Number

Patient No. Sex M F

Date

Name Census No.

Father's/Spouse's Name

Age Adm. wt. (kg.)

Residence/Village

P. S. Dist/Upazila

Distance (Kilometer)

Diarrhoea: No Loose Liquid Watery

Onset Time

Mucoid No Yes Bloody No Yes Vomiting No Yes Abd. pain No Yes Fever No Yes

Other

Dehydration: None Mild Moderate Severe

Pulse: Normal Weak Feeble Pulseless

Respiration: Normal Rapid Gasp Absent

Abd. Dist: No Yes Nutrition: Normal Thin Malnur.

CNS: Normal Convulsion Unconscious Both

Others

Clinical Diagnosis Signature

Stool M/E No Yes R/S No Yes TC. No Yes DC. No Yes Hcr%

Oral No Yes

IV No Yes

Medicine

Outcome Discharge Admitted Refd to other Hosp Died Br. Dead

Disch. Date

ADVICE & PRESCRIPTION (ICDDR,B)

PRESCRIPTION (ICDDR,B)

Patient No. Date of Admission: Patient's Name Rx Signature Date of discharge

Patient No. Patient's Name Rx Signature Date



STOOL

1 SP HANDLING	2 STAT
------------------	-----------

FOR INVESTIGATORS USE ONLY

SPECIMEN RECEIVED DD MM YY HOURS RECD BY

LABORATORY NUMBER

PATIENT NAME

IN YEARS FOR ADULT AGE IN YRS/MONTHS FOR CHILD IN DAYS FOR NEONATE

Female Male

Patient's sex Diarrhoea (Days) Fever (Days)

CLIN. REMARKS

BUDGET NUMBER

PATIENT #

- DHAKA: 001 Inpatient, 002 Out patient, 003 Study Ward, 004 Metabolic Ward, 005 Nutrition Rehabi, 006 Intensive Care, 007 Travelers Clinic, 008 Staff Clinic, 009 Animal House, 010 Surveillance, 011 Manipara, 012 Field, 013 On payment
- MATLAB: 101 Tmet Centre, 102 Navarapon, 103 Kalibazar, 104 Staff Clinic, 105 Field, 106 Thana HC, 107 MCH-FP
- TEKNAF: 201 Tmet Centre, 202 Staff Clinic, 203 Field

TESTS REQUIRED

SPECIMEN COLLECTED ON DD MM YY HOURS

Rx CID #, DGS RID #, Pm #

Macroscopic

Test Observation Code

Color

Consistency

Blood: 0 NO, 1 Trace, 2 Moderate, 3 Heavy

Mucus: No, Trace, Moderate, Heavy

Worm

PH

Microscopic - Protozoa

Code Name Vag Cyst

Giardia

E. histolytica: RBC Injwtd (0 No, 1 Yes)

Microscopic - Helminth

Code Name Observation

Ascaris: 0 No, 1 Few, 2 Mod, 3 Many

Trichuris: No, Few, Mod, Many

Hookworm: No, Few, Mod, Many

Microscopic - Other

Code Test Observation Code

RBC: 1 0, 2 1-10, 3 11-20, 4 21-50, 5 >50

Pus cells: 0-10, 11-20, 21-50, >50

Macrophages: 0, 1-5, 6-10, >10

Neutrophils: No, Few, Mod, Many

Yeasts: No, Few, Mod, Many

SPECIAL TESTS
CHECK/WRITE IF REQUIRED

Test Observation Code

Occult blood

Cryptosporidium

Tests Code

Concentration technique used: 1 Yes

User number, User signature, Tech number, Supr number, Reporting date, Reporting time, Laboratory comments, Code

DISTRIBUTION: GOLD TO ORIGINATOR, WHITE TO COMPUTER



BLOOD

1	2
SP HANDLING	STAT

TOP INVESTIGATION USE ONLY

PATIENT NAME _____

AGE IN YEARS FOR ADULT
IN YRS/MONTHS FOR CHILD
IN DAYS FOR NEONATE

Year	Month	Day

SEX

Female	Male
0	1

DIARRHOEA

No	Yes
0	1

FEVER

No	Yes
0	1

CLIN REMARKS _____

BUDGET NUMBER

--	--	--	--	--	--	--	--

PATIENT #

--	--	--	--	--	--	--	--

	DHAKA	MATIAB	ISANAI
I	001 Inpatient	101 Treat Cent	201 Treat Cent
O	002 Outpatient	102 Naverbar	202 Staff Clin
C	003 Study Ward	103 Kalmazar	203 Field
A	004 Metab Ward	104 Staff Clin	
T	005 Nut Rehab	105 Field	MIRZAPUR
I	006 Inten Care	106 Thana	301 Field
O	007 Trav Clinic	107 MCHHP	302 Staff
N	008 Staff Clinic		303 Karmati Hall
	009 Animal House		
	010 Surveillance	Other	
	011 Handpump	Code	
	012 Field	Field	
	013 On payment		

TESTS REQUIRED _____

SPECIMEN DRAWN ON

--	--	--	--	--	--	--	--

for DSS Pat

OID #							
RID #							

SPECIMEN RECEIVED

DD	MM	YY	HOURS	MIN

LABORATORY NUMBER

--	--	--	--	--	--	--	--

TOTAL WBC

--	--	--	--	--	--	--	--

HBBC

--	--	--	--	--	--	--	--

Platelets

--	--	--	--	--	--	--	--

Eosin %		Basophil %		Platelet %	
Band %		Atypical lymph %		Nucleated RBC %	
Lymphocyte %		Melanocyte %		RBC Fragment %	
Monocyte %		Myeloid %		Microcyte %	
Anisocyt %		Thrombocyte %		Leuk %	

Normocytosis

--	--	--

Microcytosis

--	--	--

Macrocytosis

--	--	--

Anisocytosis

--	--	--

Poikilocytosis

--	--	--

ESR Uncorrected

--	--	--

ESR Corrected

--	--	--

MCHV

--	--	--

MCH

--	--	--

MCHC

--	--	--

BLOOD GROUPING AND CROSS MATCH

Donor's Name/ID	Saline	MAJOR		MINOR	
		1	2	3	4
Donor's group & Rh	Albumin	Compatible	Incomp	Compatible	Incomp
Patient's group & Rh	Control	Compatible	Incomp	Compatible	Incomp

Test done

--	--	--	--	--	--	--	--

Serial number	User's signature	Tech number	Supervisor	Reporting date (dd/mm/yy)	Reporting time	Laboratory comments	Code
---------------	------------------	-------------	------------	---------------------------	----------------	---------------------	------

DISTRIBUTION GREEN ORIGINATOR WHITE TO COMPUTER ICDDR,B FORM LABE 4/96



**INTERNATIONAL CENTRE FOR
DIARRHOEAL DISEASE
RESEARCH, BANGLADESH**

URINE

1 SP. HANDLING	2 STAT
-------------------	-----------

PATIENT NAME _____

AGE: IN YEARS FOR ADULT
IN YEARS/MONTHS FOR CHILD
IN DAYS FOR NEONATE

Year	Month	Days
<input type="text"/>	<input type="text"/>	<input type="text"/>

SEX

Female	Male
<input type="checkbox"/>	<input type="checkbox"/>

DIARRHOEA

No	Yes
<input type="checkbox"/>	<input type="checkbox"/>

FEVER

No	Yes
<input type="checkbox"/>	<input type="checkbox"/>

STOMACH

No	Yes
<input type="checkbox"/>	<input type="checkbox"/>

BUGGET NUMBER

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------

PATIENT #

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------

	DHAKA	MATLAB	TEKNAF
0	001 Inpatient	101 Treat Centre	201 Treat Centre
0	002 Out patient	102 Navegaon	202 Staff Clinic
0	003 Study Ward	103 Kahrabaz	203 Field
0	004 Metabolic Ward	104 Staff Clinic	
0	005 Nutrition Rehab	105 Field	MIRZAPUR
0	006 Intensive Care	106 Thana	301 Field
0	007 Travellers Clinic	107 MCH-FP	302 Staff
0	008 Staff Clinic		303 Kumudu Hts
0	009 Animal House		
0	010 Surveillance	Other	
0	011 Nandipara		
0	012 Field		
0	013 On payment		

Code / other

SPECIMEN

00 Clean Catch	00 Catheter	01 Suprapubic
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

TESTS REQUIRED

<input type="checkbox"/>

SPECIMEN COLLECTED ON

DD	MM	YY	HOURS
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

ICD #	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
RIC #	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Order number

User signature

Tech number

Sup number

FOR INVESTIGATORS USE ONLY

SPECIMEN RECEIVED

DD	MM	YY	HOURS	RECD BY
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

LABORATORY NUMBER

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------	----------------------

PHYSICAL EXAMINATION

Color

Appearance

Specific Gravity

CHEMICAL EXAMINATION

pH Reaction

Protein

Sugar

SPECIAL TESTS

Test

Ketones

Bile salt

Bile pigment

Urobilinogen

Bilirubin

Blood

Sp. test Code

MICROSCOPIC EXAMINATION

CASTS (LPF)

CASTS (LPF)

CRISTALS & AMORPHOUS DEBRIS/LPF

Leucocytes

Erythrocytes

Epithelial cells

Granules

Hyaline

Fats

OTHERS

<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

Reporting date (dd/mm/yy)

Reporting hour

Substrate comments

CRP



**INTERNATIONAL CENTRE FOR
DIARRHOEAL DISEASE
RESEARCH, BANGLADESH**

SEROLOGY

1 SP HANDLING	2 STAT
------------------	-----------

FOR INVESTIGATORS USE ONLY

PATIENT NAME: _____

AGE:
 IN YEARS FOR ADULT: Year [] Month [] Day []
 IN 12 MONTHS FOR CHILD: [] [] []
 IN DAYS FOR NEONATE: [] [] []

SEX:
 Female: 0 Male: 1

DIARRHOEA:
 No: 0 Yes: 1

FEVER:
 No: 0 Yes: 1

CLIN. REMARKS: _____

SUBJECT NUMBER: [] [] [] [] [] [] [] [] [] []

PATIENT # [] [] [] [] [] [] [] [] [] []

	DHAKA	MATLAB	TEKNAF
I	001 Inpatient	101 Treat Centre	201 Treat Centre
O	002 Out patient	102 Hospital	202 Staff Clinic
C	003 Study Ward	103 Kambar	203 Clinic
A	004 Metabolic Ward	104 Staff Clinic	MIRZAPUR
T	005 Nutrition Rehab	105 Field	301 Field
I	006 Intensive Care	106 Thana	302 Staff
D	007 Travelers Clinic	107 MCHAF	303 Hospital Hqs
H	008 Staff Clinic		
	009 Animal House		
	010 Surveillance		
	011 Nidhara		
	012 Field		
	013 Outpatients		

TESTS REQUIRED: _____

SPECIMEN COLLECTED ON:
 DD [] [] MM [] [] YY [] [] HOURS [] [] [] []

for DSS:
 Pat. ID # [] [] [] [] [] [] [] [] [] []
 RID # [] [] [] [] [] [] [] [] [] []

User number [] [] [] User Signature _____ Tech number [] [] [] [] [] [] [] [] [] []
 Sub number [] [] [] [] [] [] [] [] [] []

SPECIMEN RECEIVED

DD [] [] MM [] [] YY [] [] HOURS [] [] [] [] RECD BY [] [] [] [] [] []

LABORATORY NUMBER

[] []

TEST

RESULT

TEST	RESULT	CODE
<input type="checkbox"/> Widal	_____	[] []
Typhoid 'O'	_____	[] []
Typhoid 'H'	_____	[] []
Paratyphoid 'AO'	_____	[] []
Paratyphoid 'AH'	_____	[] []
Paratyphoid 'BO'	_____	[] []
Paratyphoid 'BH'	_____	[] []
<input type="checkbox"/> Weil Felix	_____	[] []
Proteus O12	_____	[] []
Proteus O15	_____	[] []
Proteus O19	_____	[] []
<input type="checkbox"/> Brucella laboratory	_____	[] []
<input type="checkbox"/> VDRL	_____	[] []
<input type="checkbox"/> ASD test	_____	[] []
<input type="checkbox"/> Pregnancy test	_____	[] []
<input type="checkbox"/> Rheumatoid factor	_____	[] []
<input type="checkbox"/> Paul Bunnell test	_____	[] []
<input type="checkbox"/> HBsAg	_____	[] []

[] []

User number [] [] [] User Signature _____ Tech number [] [] [] [] [] [] [] [] [] [] Sub number [] [] [] [] [] [] [] [] [] [] Reporting date (dd/mm/yy) [] [] [] [] [] [] [] [] [] [] Reporting hour [] [] [] [] Laboratory comments _____ Code [] []

APPENDIX - B

PROGRAM LISTING

```
do pre
* this part of the program is for opening menu of the program
set status off
clear
@ 1,0 to 4,64 double
@ 5,0 to 22,64 double
@ 2,22 say "WELCOME TO"
@ 3,10 say "HOSPITAL INFORMATION SYSTEM"
@ 6,5 say "Select"
@ 8,10 say "1 For Patient Admission"
@ 10,10 say "2 For Inhouse Patient Care"
@ 12,10 say "3 For Administrative Control"
@ 14,10 say "4 For Out_Patient Data Entry"
@ 16,10 say "5 For Database Handling in SQL"
@ 18,10 say "6 For Exit to DOS"
choice = 0
@ 20,5 say "Please Enter Your Choice" get choice picture "#"
range 1,6
read
do case
  case choice = 1
  clear
  do qry1
  case choice = 2
  clear
  do qry2
  return
  case choice = 3
  clear
  do qry3
  return
  case choice = 4
  clear
  do qry4
  return
  case choice = 5
  clear
  return
  return
  return
  case choice = 6
```

```

clear
quit
endcase
*=====
* this procedure is for initialising the environment
procedure pre
set talk off
set status off
not escape on
not bell off
return
*=====
*=====
* this procedure provide information on vaccant beds of hospital
procedure qry11
clear
set talk off
set status off
@ 0,0 to 2,70 double
@ 1,4 say "This query displays vaccant beds of a
ward---Hospital Information"
ward_no = space(2)
@ 3,8 say "Please Enter Ward Number " get ward_no
read
@ 4,1 to 23,70 double
use ward
locate for wardno = ward_no
@ 3,39 say "Total Number of beds "
@ 3,60 say bednos
bed_nos = val(bednos)
use ipward
@ 5,4 say "Beds lying vaccant are; "
bed_no = 001
i = 7
j = 0
beddisp = space(4)
do while bed_no < bed_nos + 1
scan for wardno = ward_no.and. val(bedno) = bed_no
store bed_no + 1 to bed_no
endscan
if bed_no < bed_nos +1
beddisp = str(bed_no,4,0)
@ i,j say trim(beddisp)
j = j + 4

```

```

if j > 70
j = 0
i = i + 1
endif
endif
store bed_no + 1 to bed_no
enddo
?
input "Enter bed number for Patient's admission or 0 for
previous page " to bed_no
if bed_no = 0
clear
do qry1
return
endif
clear
do qry120
return
return
*=====
* Data entry procedure for inpatient
procedure qry120
clear
@ 0,0 to 2,70 double
@ 1,3 say " In_patient Data Entry ---- Hospital Information
System"
@ 2,0 to 23,70 double
bed_nos = space(3)
bed_nos = str(bed_no,3,0)
@ 3,4 say "The Alloted Bed Number is "+bed_nos+" and the Ward
Number is "+ward_no
use inpat
go bottom
inpat_no = 0
store val(inpatno) + 1 to inpat_no
in_patno = space(6)
in_patno = str(inpat_no,6,0)
outpat_n = space(6)
inpatn_m = space(20)
grdn_nam = space(15)
ag_e = space(3)
se_x = space(1)
store ctod("00/00/00") to dt_admit
res_add = space(35)

```

```

tel_r = space(6)
re_fer = space(15)
re_m = space(10)
@ 4,4 say "Please Note the Patient Number "+in_patno
@ 5,2 say "Enter Out Patient Number :" get outpat_n
@ 6,2 say " Enter the Patient Name: " get inpatn_m
@ 7,2 say " Enter the Gardian Name: " get grdn_nam
@ 8,2 say " Enter Age of Patient: " get ag_e
@ 9,2 say " Enter Sex of Patient (M/F): " get se_x
@ 10,2 say " Enter Date of Admission : " get dt_admit
@ 11,2 say " Enter Address: " get res_add
@ 12,2 say " Enter Residence Telephone Number : " get tel_r
@ 13,2 say " Enter Patient Referral: " get re_fer
@ 14,2 say " Enter Remark if any: " get re_m
read
keep = space(1)
@ 20,2 say "Is the Entered Data Correct ? If please press Y ,"
@ 22,2 say "Otherwise press N :" get keep
read
if upper(keep) = "N"
    do qry120
    return
endif
if upper(keep) = "Y"
    use outinpat
    append blank
    replace inpatno with in_patno
    replace outpatno with outpat_n
    use ipward
    append blank
    replace inpatno with in_patno
    replace wardno with ward_no
    replace bedno with bed_nos
    use inpat
    append blank
    replace inpatno with in_patno
    replace inpatnam with inpatn_m
    replace grdnnam with grdn_nam
    replace age with ag_e
    replace sex with se_x
    replace dtadmit with dt_admit
    replace resadd with res_add
    replace telr with tel_r
    replace refer with re_fer

```

```

replace rem with re_m
rt = space(1)
accept " If you want to Admit more Please press Y , other
key for main Menu :" to rt
    if upper(rt) = "Y"
        do tst
        return
    endif
endif
do hos
return
*=====
* query processing procedure on patient care activities
procedure qry2
@ 1,0 to 3,70
@ 5,0 to 23,70
@ 2,5 say "Patient Care Activities ----- Hospital Information
System"
@ 6,5 say "Select"
@ 8,10 say " 1 For General Condition Information of a Patient"
@ 10,10 say " 2 For Pathological Information of a Patient"
@ 12,10 say " 3 For Medicine Administration of a Patient"
@ 14,10 say " 4 For Adding New General Condition Data "
@ 16,10 say " 5 For Adding Pathological Test Information"
@ 18,10 say " 6 For Adding Prescribed Medicine Administration
Schedule"
@ 20,10 say " 7 For Previous Page"
sel = 0
@ 22,5 say " Please Enter Your Choice :" get sel picture "#"
range 1,7
read
do case
    case sel = 1
        do qry21
        return
    case sel = 2
        do qry22
        return
    case sel = 3
        do qry23
        return
    case sel = 4
        do qry24
        return

```

```

    case sel = 5
      do qry25
      return
    case sel = 6
      do qry26
      return
    case sel = 7
      clear
      do hosi
      return
  endcase
  *=====
  * procedure for query processing on General condition
  procedure qry21
  clear
  @ 1,0 to 3,70 double
  @ 2,2 say "Patient's General Condition ----- Hospital
  Information"
  @ 3,0 to 23,70 double
  ward_no = space(2)
  bed_no = space(3)
  @ 4,5 say "Enter Ward Number :" get ward_no
  @ 4,35 say "Enter Bed Number :" get bed_no
  read
  use ipward
  go top
  locate for val(wardno) = val(ward_no) .and. val(bedno) =
  val(bed_no)
  @ 6,5 say "The Number of the Patient is : "+inpatno
  @ 8,0 say " "+"DATE"+" "+"TIME"+" "+"STOOL"+" "+"TEMP"+"
  "+"BP"+" "+"BP"+" "+"HRT"+" "+"COMMENT"+" "+"REMARK"
  @ 9,0 say " "+"OBSRV"+" "+"CEL"+" "+"DYS"+"
  "+"SYS"+" "+"BIT"
  i = 11
  j = 0
  inpat_no = space(6)
  inpat_no = inpatno
  con_code = space(6)
  close database
  select 1
  use ippathav
  go top
  scan for inpatno = inpat_no
  inpat_no = inpatno

```



```

@ i,j say dtoc(exmdate)+" "+exmtime+" "
j = j + 15
con_code = condcode
select .2
use conditn
go top
locate for val(condcode) = val(con_code)
@ i,j say motion+" "+tempc+" "+bpdys+" "+bpsys+" "+htbit+"
"+coment+" "+rem
j = 0
i = i + 1
select 1
endscan
?
?
?
wait
clear
close database
do qry2
return
*=====
*Data entry procedure on General condition
procedure qry24
clear
@ 1,1 to 3,70 double
@ 2,2 say "Adding General Condition Data --- Hospital
Information"
ward_no = space(2)
bed_no = space(3)
@ 4,1 to 23,70 double
@ 5,5 say "Enter Ward Number : " get ward_no
@ 5,35 say "Enter Bed Number : " get bed_no
read
store space(6) to in_patno
use ipward
go top
locate for val(wardno) = val(ward_no) .and. val(bedno) =
val(bed_no)
@ 6,5 say " The Number of the Patient is : "+inpatno
in_patno = inpatno
con_code = space(6)
use conditn
go bottom

```

```

store str((val(condcode) + 1),6,0) to con_code
store space(6) to mo_tion
store space(3) to temp_c
store space(3) to bp_dys
store space(3) to bp_sys
store space(3) to ht_bit
store space(20) to sp_find
store space(20) to com_ent
store space(10) to re_m
store space(1) to ans
store space(8) to exm_date
store space(4) to exm_time
@ 9,5 say "Please Enter Motion Appearance : " get mo_tion
@ 10,5 say "Enter Temperature in Degree Celcius : " get temp_c
@ 11,5 say "Enter Diastolic Blood Pressure : " get bp_dys
@ 12,5 say "Enter Systolic Blood Pressure : " get bp_sys
@ 13,5 say "Enter Heart Bit : " get ht_bit
@ 14,5 say "Enter Special Findings : "
@ 15,10 get sp_find
@ 16,5 say "Enter Comments or Food restrictions : "
@ 17,10 get com_ent
@ 18,35 say "Enter Remarks : " get re_m
@ 19,5 say "Enter Date : " get exm_date
@ 19,35 say "Enter Time : " get exm_time
@ 21,2 say "If the data entered above is correct please press Y
"
@ 22,2 say "otherwise press N : " get ans
read
if upper(ans) = "N"
    clear
    do qry24
    return
endif
if upper(ans) = "Y"
    use ippathav
    append blank
    replace condcode with con_code
    replace inpatno with in_patno
    replace exmdate with ctod(exm_date)
    replace exmtime with exm_time
    use conditn.
    append blank
    replace condcode with con_code
    replace motion with mo_tion

```

```

replace tempc with temp_c
replace bpdys with bp_dys
replace bpsys with bp_sys
replace htbit with ht_bit
replace spfind with sp_find
replace coment with com_ent
replace rem with re_m
wait
clear
do qry2
return
endif
clear
do qry2
return
return
*=====
* This procedure is for query processing on pathological tests
procedure qry22
clear
@ 1,0 to 3,70 double
@ 2,2 say "Patient's Pathological Findings ----- Hospital
Information"
@ 3,0 to 23,70 double
ward_no = space(2)
bed_no = space(3)
@ 4,5 say "Enter Ward Number :" get ward_no
@ 4,35 say "Enter Bed Number :" get bed_no
read
use ipward
go top
locate,for val(wardno) = val(ward_no) .and. val(bedno) =
val(bed_no)
@ 6,5 say "The Number of the Patient is : "+inpatno
@ 8,0 say "   "+"DATE"+"   "+"TIME"+"   "+"SAMPLE"+"
"+"COMMENT"+"           "+"FINDING"
i = 9
j = 0
sampl_nam = space(15)
sampl_e = space(2)
inpat_no = space(6)
inpat_no = inpatno
path_code = space(6)
close database

```

```

select 1
use ippath
go top
scan for inpatno = inpat_no
inpat_no = inpatno
@ i,j say dtoc(exmdate)+" "+exmtime+" "
j = j + 15
path_code = pathcode
select 2
use pathology
go top
locate for val(pathcode) = val(path_code)
sampl_e = sample
select 3
use dicpath
locate for val(sample) = val(sampl_e)
sampl_nam = samplnam
select 2
@ i,j say sampl_nam+" "+coment+" "+finding
j = 0
i = i + 1
select 1
endscan
?
wait
clear
close database
do qry2
return
*=====
* Medicine timings and query processing
procedure qry23
clear
@ 1,0 to 3,70 double
@ 2,2 say "Patient's Medicine Administration ----- Hospital
Information"
@ 3,0 to 23,70 double
ward_no = space(2)
bed_no = space(3)
@ 4,5 say "Enter Ward Number :" get ward_no
@ 4,35 say "Enter Bed Number :" get bed_no
read
use ipward
go top

```

```

locate for val(wardno) = val(ward_no) .and. val(bedno) =
val(bed_no)
@ 6,5 say "The Number of the Patient is : "+inpatno
@ 8,0 say " "+"DATE"+" "+"TIME"+" "+"MEDICINE NAME"+"
"+"DOSE"+" "+"DOSE"+" "+"DOSE"+" "+"DOSE"+" "+"OTHER"
@ 9,0 say " "+"I"+"
"+"II"+" "+"III"+" "+"IV"+" "+"INSTRUCTIONS"
i = 10
j = 0
inpat_no = space(6)
inpat_no = inpatno
med_code = space(6)
close database
select 1
use ippattak
go top
scan for inpatno = inpat_no
inpat_no = inpatno
@ i,j say dtoc(dategvn)+" "+timegvn+" "
j = j + 15
med_code = medcode
select 2
use medicine
go top
locate for val(medcode) = val(med_code)
@ i,j say medname+" "+dose1+" "+dose2+" "+dose3+" "+dose4+"
"+splinst
j = 0
i = i + 1
select 1
endscan
?
wait
clear
close database
do gry2
return
*=====
* Data entry procedure for pathological tests
procedure gry25
clear
@ 1,0 to 3,70 double
@ 2,2 say "Adding Pathological Information Data --- Hospital
Information"

```

```

@ 3,0 to 23,70 double
ward_no = space(2)
bed_no = space(3)
@ 4,5 say "Enter Ward Number : " get ward_no
@ 4,35 say "Enter Bed Number : " get bed_no
read
store space(6) to in_patno
use ipward
go top
locate for val(wardno) = val(ward_no) .and. val(bedno) =
val(bed_no)
@ 6,5 say " The Number of the Patient is : "+inpatno
in_patno = inpatno
path_cod = space(6)
use pathlogy
go bottom
store str((val(pathcode) + 1),6,0) to path_cod
store space(6) to sam_ple
store space(60) to find_ing
store space(20) to com_ent
store space(10) to re_m
store space(1) to ans
store space(8) to exm_date
store space(4) to exm_time
@ 9,5 say "Please Enter Sample Code : " get sam_ple
@ 14,5 say "Enter Findings : "
@ 15,10 get find_ing
@ 16,5 say "Enter Comments : "
@ 17,10 get com_ent
@ 18,35 say "Enter Remarks : " get re_m
@ 19,5 say "Enter Date : " get exm_date
@ 19,35 say "Enter Time : " get exm_time
@ 21,0 say " If the data entered above is correct please press
y "
@ 22,0 say "otherwise press N : " get ans
read
if upper(ans) = "N"
    clear
    do qry25
    return
endif
if upper(ans) = "Y"
    use ippath
    append blank

```

```

replace pathcode with path_cod
replace inpatno with in_patno
replace exmdate with ctod(exm_date)
replace exmtime with exm_time
use pathology
append blank
replace pathcode with path_cod
replace sample with sam_ple
replace finding with find_ing
replace coment with com_ent
replace rem with re_m
wait
clear
do qry2
return
endif
clear
do qry2
return
*=====
* Data entry procedure for medicine
procedure qry26
clear
@ 1,0 to 3,70 double
@ 2,2 say "Adding Medicine Administration Schedule --- Hospital
Information"
@ 3,0 to 23,70 double
ward_no = space(2)
bed_no = space(3)
@ 4,5 say "Enter Ward Number : " get ward_no
@ 4,35 say "Enter Bed Number : " get bed_no
read
store space(6) to in_patno
use ipward
go top
locate for val(wardno) = val(ward_no) .and. val(bedno) =
val(bed_no)
@ 6,5 say " The Number of the Patient is : "+inpatno
in_patno = inpatno
med_code = space(6)
use medicine
go bottom
store str((val(medcode) + 1),6,0) to med_code
store space(20) to med_name

```

```

store space(15) to ds_dcrp
store space(4) to dose_1
store space(4) to dose_2
store space(4) to dose_3
store space(4) to dose_4
store space(3) to day_wise
store space(4) to time_day
store space(15) to spl_inst
store space(10) to re_m
store space(1) to ans
store space(8) to date_gvn
store space(4) to time_gvn
@ 9,5 say "Please Enter Medicine Name : " get med_name
@ 10,5 say "Enter Description of the Dose : " get ds_dcrp
@ 11,5 say "Enter Time of First Dose : " get dose_1
@ 12,5 say "Enter Time of Second Dose : " get dose_2
@ 13,5 say "Enter Time of Third Dose : " get dose_3
@ 14,5 say "Enter Time of Fourth Dose : " get dose_4
@ 15,5 say "Enter Time Interval for Daywise Dose : " get
day_wise
@ 16,5 say "Enter Time When to be Administered : " get time_day
@ 17,5 say "Enter Special Instruction if any : " get spl_inst
@ 18,5 say "Enter Remarks : " get re_m
@ 19,5 say "Enter Date : " get date_gvn
@ 19,35 say "Enter Time : " get time_gvn
@ 21,0 say " If the data entered above is correct please press
Y "
@ 22,0 say "otherwise press N : " get ans
read
if upper(ans) = "N"
    clear
    do gry24
    return
endif
if upper(ans) = "Y"
    use ippattak
    append blank
    replace medcode with med_code
    replace inpatno with in_patno
    replace dategvn with ctod(date_gvn)
    replace timegvn with time_gvn
    use medicine
    append blank
    replace medcode with med_code

```



```

replace medname with med_name
replace dsdcrp with ds_dcrp
replace dose1 with dose_1
replace dose2 with dose_2
replace dose3 with dose_3
replace dose4 with dose_4
replaco daywiso with day_wise
replace timeday with time_day
replace splinst with spl_inst
replace rem with re_m
wait
clear
do qry2
return
endif
clear
do qry2
return
*=====
* The procedure is for patient's admission proceedings
* qry1 - program procedure
procedure qry1
@ 2,2 to 4,69 double
@ 3,5 say "HOSPITAL INFORMATION _ PATIENT ADMISSION"
@ 6,1 to 20,70 double
admit = 0
@ 9,5 say "Select: "
@ 11,10 say " 1 For Ward Information"
@ 13,10 say " 2 For Bed Occupancy in a Particular Ward"
@ 15,10 say " 3 For Previous Screen"
@ 17,10 say " 4 For Exit"
@ 19,5 say "Please Enter Your Chioce " get admit picture "#"
range 1,4
read
do case
  case admit = 1
  clear
  do qry10
  case admit = 2
  do qry11
  case admit = 3
  clear
  do hosi
  case admit = 4

```

```

return
endcase
return
*=====
*The procedure is for identification of ward numbers
* qry10 procedure
procedure qry10
set escape on
@ 2,3 say " This query Provide Information on Ward number, ---
Hospital Information "
@ 3,3 say " Name of Ward and Total number of Beds"
@ 1,2 to 4,76 double
use ward
@ 8,1 say "WARD"+" "+"NAME OF "+" "+"TOTAL"+"
"+"WARD"+" "+"NAME OF "+" "+"TOTAL"
@ 9,1 say "NO"+" "+"THE WARD "+" "+"BEDS"+"
"+"NO"+" "+"THE WARD "+" "+"BEDS"
recod = int(reccount()/2)+1
@ 7,0 to recod+10,70 double
@ 7,33 to recod+10,33
i = 10
j = 2
do while .not. eof()
@ i,j say wardno + " " + wardname + " " + bednos + " "
skip
j = j + 35
if j > 70 .or. j = 70
j = 2
i = i + 1
endif
enddo
?
?
?
wait
clear
do qry1
return
*=====
* The procedure below is for Administrative Control"
procedure qry3
@ 1,1 to 3,75 double
@ 2,2 say "Administrative Control ----- Hospital Information
System"

```

```

@ 4,1 to 23,75 double
@ 6,3 say "Select :"
@ 8,10 say "1 For Query on Individual's Duty"
@ 10,10 say "2 For Query on Ward Duties"
@ 12,10 say "3 For Query on Bed Occupancy of a Ward"
@ 14,10 say "4 For Changing Duty Schedule"
@ 16,10 say "5 For Changes in Ward Data"
@ 18,10 say "6 For Changing/Adding Personnel Data"
@ 20,10 say "7 For Previous Page"
sel = 0
@ 22,3 say "Please Enter Your Choice :" get sel picture "#"
range 1,7
read
do case
  case sel = 1
    do qry31
    return
  case sel = 2
    do qry32
    return
  case sel = 3
    do qry33
    return
  case sel = 4
    do qry34
    return
  case sel = 5
    do qry35
    return
  case sel = 6
    do qry36
    return
  case sel = 7
    return
endcase
return
*=====
* This procedure provides information on duty schedules
procedure qry31
@ 1,1 to 3,75 double
@ 2,3 say "Query Processing on Personnel's Duty----Hospital
Information"
@ 4,1 to 20,75 double
@ 5,2 say "EMP EMPLOYEE DESIGNATION EMP EMPLOYEE

```

```

DESIGNATION"
@ 6,2 SAY " NO NAME NO NAME
"
I = 7
J = 2
USE STAFF
DO WHILE .NOT. EOF()
  @ I,J SAY STFNO+" "+STFNAM+" "+DESIG
  SKIP
  @ I,J+35 SAY STFNO+" "+STFNAM+" "+DESIG
  SKIP
  I = I+1
  IF I>20
    I = 7
    J = 2
  ENDIF
ENDDO
@ 22,5 SAY "PLEASE ENTER EMPLOYEE NO :" GET EN PICTURE "##"
RANGE 1,99
@ 5,1 TO 25,75 CLEAR
@ 6,2 SAY "THE DUTY SHEDULE FOR THE EMPLOYEE NUMBER ENTERED "
SELECT 1
USE STAFF
LOCATE FOR VAL(STFNO) = EN
@ 8,2 SAY "EMPLOYEE NAME "+STFNAM
@ 10,5 SAY "DUTY STARTS "+"DUTY ENDS "+"DUTY LOCATION "
@ 11,5 SAY DTYSTA+" "+DTYEND
I = 11
J = 30
WDNO = SPACE(2)
SELECT 2
USE STFWRKWD
DO WHILE .NOT. EOF()
  LOCATE FOR VAL(STFNO) = EN
  WDNO = WRDNO
  SELECT 3
  USE WARD
  LOCATE FOR WARDNO = WDNO
  @ I,J SAY WARDNAM
  I = I+1
ENDDO
RETURN

```

*=====

* This procedure provides informatin on wards

```

* gry32 procedure
procedure gry32
set escape on
@ 2,3 say " Information on Ward number for duty shedule, ---
Hospital Information "
@ 3,3 say " Name of Ward and Total number of Beds"
@ 1,2 to 4,76 double
use ward
@ 8,1 say "WARD"+" " +"NAME OF " "+" " +"TOTAL"+"
"+"WARD"+" " +"NAME OF " "+" " " +"TOTAL"
@ 9,1 say "NO"+" " +"THE WARD " "+" " " +"BEDS"+"
"+"NO"+" " +"THE WARD " "+" " " " +"BEDS"
recod = int(reccount()/2)+1
@ 7,0 to recod+10,70 double
@ 7,33 to recod+10,33
i = 10
j = 2
do while .not. eof()
@ i,j say wardno + " " + wardname + " " " + bednos + " " "
skip
j = j + 35
if j > 70 .or. j = 70
j = 2
i = i + 1
endif
enddo
?
?
?
wait

clear
return
*=====
* this procedure is for data Entry of the Outdoor Patient
*procedure gry4
procedure gry4
@ 1,1 to 3,75 double
@ 2,3 say "Outpatient Data Entry -----Hospital Information System"
outpt_no = space(6)
out_nam = space(20)
ag_e = space(3)
se_x = space(1)
dt_atn = ctod(00/00/00)

```

```
med_1 = space(10)
med_2 = space(10)
med_3 = space(10)
med_4 = space(10)
med_5 = space(10)
med_6 = space(10)
com_ent = space(15)
@ 4,1 to 23,75 double
@ 5,5 say "Enter the data given below :".
@ 7,10 say "Outpatient Number :" get outpt_no
@ 8,10 say "          Name :" get out_nam
@ 9,10 say "          Age :" get ag_e
@ 10,10 say "          Date :" get dt_atn
@ 11,10 say "          Medicine One :" get med_1
@ 12,10 say "          Medicine Two :" get med_2
@ 13,10 say "          Medicine Three :" get med_3
@ 14,10 say "          Medicine Four :" get med_4
@ 15,10 say "          Medicine Five :" get med_5
@ 16,10 say "          Medicine Six :" get med_6
***** more to be done later *****
```

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