ACKNOWLEDGEMENT

I wish to express my deep sense of gratitude to Prof Sundeep Sahay, President, H*i*SPindia for giving me great opportunity to do my Dissertation at H*i*SPindia, Shimla.

I hereby express my deep gratitude towards Ms. Arunima S Mukherjee, Project-Lead Coordinator, H*i*SPindia, and Ms. Rashi Banta, Project-Lead Coordinator, H*i*SPindia, for their valuable guidance, support, interest, involvement, encouragement and advice. They inspired us greatly to work on this project.

My sincere acknowledgement goes to Prof Indrajit Bhattacharya and Prof Anandhi Ramachandran for their kind assistance and support throughout our dessertation.

Finally, an honorable mention goes to my family and friends for their understanding and support in completing this project.

Thank You

ABSTRACT

Customization of Hospital Information System for Civil Hospital, Mohali

Problem Statement & Its Importance to study

Pre-implementation assessment helps in reducing the uncertainty, acquiring local knowledge, and thus increasing the likelihood of success of the implementation. Understanding as much as possible before implementation is initiated, is important to ensure that implementation strategies are appropriate and take into account the socio-economic realities.

Hospital-based customization provides a means of achieving this timeliness with maximum user satisfaction. It, however, requires a major commitment in personnel time as well as additional software and also proper steps and processes for customizing .The enhanced control of system modifications and overall flexibility in planning the change process result in enthusiastic support of this approach by many hospitals. The key factors for success include careful selection of local personnel with adequate technical support, extensive QA control, and thorough auditing /validation and user involvement. Customized data delivery technology provides real and tangible value to end users, accentuates workflow. Thus it is necessary to understand the customization process.

Objective

Study the pre-implementation evaluation of the process flow and defining the steps and the process involved in customization and testing of HIS for Civil Hospital, Mohali.

Literature Review

The purpose of a pre-implementation assessment is to provide a picture of the past and present situation in order to inform future decisions. That is, it is the "the construction of a possible future" by inscribing it into the present and future decisions of the organizations (Smithson & Tsiavos 2004).

One of the Technical report by J. Sarivouyioukas* – A. Vagelatos on Introduction of Clinical Information System In a Regional General State Hospital of Athens, Greece said that in the implementation plan customization is done according to the specific requirements of the hospital. So the contents of the customization are only 10% different for various hospitals to be integrated which is found in the special sub-divisions in the hospital.

Methodology (site/timelines/method of data collection/data sources)

This study of pre-implementation evaluation of the hospital process would be carried out at Civil Hospital Mohali from and the study of customization of HIS would be carried out at the Implementers Office from March 15th to March 20th.

For the pre-implementation evaluation the following steps would be carried out:

1) Studying the hospital process with the help of questionnaire with hospital staff.
2) To understand the waiting time of patients with questionnaire of patients.

As customization of HIS is a descriptive study with the primary objective of defining the steps involved in the process of customization of an HIS for a Hospital. Thus a detailed study with following steps would be carried out:

1) Formulating the database for the hospital based on the respective requirements.
2) Analyzing the difference in the customization protocols of HIS between Shimla and Mohali hospital

3) Customization of HIS according to the hospital requirements i.e. Role based access control, Customizing the modules (managing departments) - OPD & IPD, Laboratory and Radiology, Blood bank & Inventory.
4) Defining the Testing protocols.
5) Analyzing the gaps in the customization during the testing. Thus, enlisting the shortcomings and difficulties experienced during the process.

Expected results

At the end of the customization and testing of the HIS (Hospital Information System)

1) Identification of the waiting time at different levels of the hospital process.
2) Identification of the process workflows in the hospital.
3) A customized data delivery technology would be there to provide real and tangible value to end user.
4) Identification of the gaps in the process

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ABBREVIATIONS

HIS: Hospital Information System

HMIS: Hospital Management Information System

OPD: Out Patient Department

IPD: In- Patient Department

QA: Quality Assurance

RSBY: Rashtriya Swastha Bima Yojana

ICD-10: International Classification of Disease

SNOMED-CT: Systematized Nomenclature of Disease- Clinical Terminology

BPL: Below Poverty Line

STP: Software Test Plan

IEEE Test plan:

SRS : System Requirement Specification

IT: Information Technology

SPSS:

BB: Blood Bank

PART 1: INTERNSHIP REPORT

1.1 HiSPindia PROFILE

HiSPindia is a not-for-profit NGO specializing since more than a decade in designing and implementing solutions in health informatics for the public health sector in Indian states, and also recently in Bangladesh and Sri Lanka. It is not a solely technology focused organization, but a multi-disciplinary organization concentrating on the domains of public health and informatics. The organization has a strong commitment to free and open source technologies, and works with a global perspective of the **Health Information Systems Programmes (HISP) network**, coordinated by the University of Oslo, Norway, and is active in more than 20 countries in Africa and Asia. HiSPindia has a registered and head office in New Delhi, and project offices in Kerala, Himachal Pradesh, and Punjab. The team members are intensively travelling to different parts of the country to provide technical support services.

i. VISION

"To enable and coordinate a network of excellence in public health informatics, specializing in integrated health information architectures, with a geographical focus on South-East Asia."

ii. HISTORY

In 1999, an informal group of idealists got together to start a project in a primary health centre in the remote villages of Kuppam, Chittoor district in Andhra Pradesh. These efforts were supported by the University of Oslo, Norway, and had initial partnerships with IIM Bangalore and ASCI Hyderabad. During the first five years, it remained focused on Andhra Pradesh and carried out implementations of the first version of the DHIS software application. From 2005, it

started to work in the State of Kerala first in one facility and by 2008 all the facilities were reporting data in the DHIS2. The DHIS2, which is a global standard today for facility reporting, took birth in a clinic in Kerala in 2006. The achievements in Kerala prompted the state of Gujarat first, and then Jharkhand and Madhya Pradesh to initiate DHIS2 implementations. This led to collaboration in 2008 at the national level with National Health Systems Resource Centre (NHSRC) to provide technical support on DHIS2 nationally. About 25 states took up DHIS2 in 2008. Today, HISP has gained international recognition, and has also been invited to provide technical support in Bangladesh, Sri Lanka, Rwanda, and Philippines.

iii. GEOGRAPHICAL COVERAGE

With a 30 team members, HISP has a strong national and global coverage of work. In India, it has worked in at least 90% of the states, and currently has a presence in about 20 states. Internationally, H*i*SPindia has worked in Bangladesh and Sri Lanka, and on an individual basis, experts have contributed to Global HISP activities in various countries including Vietnam, Tanzania, Zanzibar, Ethiopia, Mozambique, South Africa, and those in West Africa.

Activities	February				March				April			
	Week 1	Week 2	Week 3	Week 4	Week 1	Week 2	Week 3	Week 4	Week 1	Week 2	Week 3	Week 4
Introduction to open MRS												
Finalization of dissertation topic												
Allotment, Documentation and concept finalization of allotted hospital												
Preparation of database for hospitals												
Literature review for dissertation												
Testing of Mandi, hamirpur and Kullu modules												
Testing of Mohali modules												
Questionnaire for Dissertation												
Development of Baselines												
Testing and Training in Mohali												
Documentation and customization of Mohali Modules												
Mobile-based reporting training												
First draft of the report												
PMCH & NMCH Requirements												
Finalization of the report												

OpenMRS is an application which enables design of a customized medical records system with no programming knowledge (although medical and systems analysis knowledge is required). It is a common framework upon which medical informatics efforts in developing countries can be built.

OpenMRS is also a community of people working to apply health information technologies to solve problems, primarily in resource-poor environments. We are a proud community of developers, implementers, funders, and users all trying to make the world a better place by using our expertise to improve the health and wellness of the planet.

OpenMRS is for people that need to implement a medical records system. It is both just a library of API calls and a database and a default implementation of those API calls in the form of a web application.

OpenMRS is a free, open-source program. All of the core resources needed are open source and freely available.

OpenMRS is backed by a data model driven by a concept dictionary, allowing for the collection of coded, reusable data without requiring changes to the data model. Furthermore, OpenMRS is not based on an HIV-centric data model, so it can be adapted for use in tuberculosis, malaria, or general medical care. OpenMRS is based upon a program which has been used effectively for over 30 years at Regenstrief Institute.

OpenMRS is programmed in Java and the core application works through a web-browser. Hibernate is used as an interface layer to the database. Tomcat is used as the web application server. The back end database is currently in MySQL. The system creates XML schemas for form design. Form design and form data entry is currently done in Microsoft Infopath, HTML, or XForms. When form data entered is submitted, it is converted into a HL7 message before going into the database.

PART 2:

Dissertation on "PRE-IMPLEMENTATION EVALUATION & CUSTOMIZATION OF HOSPITAL INFORMATION SYSTEM IN CIVIL HOSPITAL, MOHALI"

Chapter 1: INTRODUCTION TO STUDY

Over the last few decades, medical sciences have significant progress leading to improvements in the modes of investigations, therapeutic activities and surgical procedures. This has enhanced the need to have authentic and accurate medical records of the patients. **Health Information System (HIS)** is one of the most promising applications of Information Technology (IT) in the Health Care Sector. The aim of HIS is to use a network of computers to collect, process and retrieve patient care and administrative information from various departments for all hospital activities. It also helps in decision-making for developing comprehensive health care policies.

Pre-implementation assessment helps in reducing the uncertainty, acquiring local knowledge, and thus increasing the likelihood of success of the implementation. Understanding as much as possible before implementation is initiated, is important to ensure that implementation strategies are appropriate and take into account the socio-economic realities.

The HIS comprises of an electronic patient record which forms the core of the system and links it to all other departments in the hospital where every department can be viewed baas an information-processing agency. Present process reveals that the existing manual system at Civil Hospital, Mohali requires up-gradation to meet the requirements of the managers and the clinicians. The management at Civil Hospital, Mohali feels HIS assists in decision making, and medical audit. It is also felt that the existing manual process flow resulted in longer time for OPD consultation and delay in investigation results. So to evaluate our system efficiently a pre-implementation survey was conducted to understand the outpatient and inpatient process waiting time and also to judge the computer proficiency of the hospital staff so as to formulate a training plan . The data was collected in form of a questionairre, the sample was the end-users of the

system. This would be helpful in not only analysing their needs but also to judge their level of understanding and their expectation and eventually after implementation the efficiency of our system.

Hospital-based customization provides a means of achieving this timeliness with maximum user satisfaction. It, however, requires a major commitment in personnel time as well as additional software and also proper steps and processes for customizing .The enhanced control of system modifications and overall flexibility in planning the change process result in enthusiastic support of this approach by many hospitals. The key factors for success include careful selection of local personnel with adequate technical support, extensive QA control, and thorough auditing /validation and user involvement. Customized data delivery technology provides real and tangible value to end users, accentuates workflow. Thus it is necessary to understand the customization process.

One of the Technical report by J. Sarivouyioukas* – A. Vagelatos on Introduction of Clinical Information System In a Regional General State Hospital of Athens, Greece said that in the implementation plan customization is done according to the specific requirements of the hospital. So the contents of the customization are only 10% different for various hospitals to be integrated which is found in the special sub-divisions in the hospital.

The purpose of a pre-implementation assessment is to provide a picture of the past and present situation in order to inform future decisions. That is, it is the "the construction of a possible future" by inscribing it into the present and future decisions of the organizations (Smithson & Tsiavos 2004).

Civil Hospital, Mohali is one of the government hospital of Mohali. The Total no. of beds in this hospital is 120, of which 80 beds are functional; and total no. of wards is 14 among which 13 wards are functional. There are 13 OPD's in the hospital with 2 registration and billing units. One is the normal registration (8:00 AM to 2:00 PM) and other is the emergency registration (After 2:00 PM).

The Study is divided into 2 parts: Pre-implementation evaluation and Customization & Testing of HIS.

Chapter 2:
OBJECTIVES

2.1 Pre-implementation Study: This study was done to understand the waiting time at the various steps of the inpatient and outpatient processes.

2.2 Customization and Testing of HIS*:* The study was done to understand the following aspects:

1) Formulating the database for the Civil hospital based on the respective requirements.
2) Customization of HIS according to the hospital requirements i.e. Role based access control, Customizing the modules (managing departments) - OPD & IPD, Laboratory and & Inventory.
3) Defining the Testing protocols.
4) Analyzing the gaps in the customization during the testing. Thus, enlisting the shortcomings and difficulties experienced during the process.

Chapter 3:
DATA AND METHODS

3.1 Site and Time line:

This study of pre-implementation evaluation of the hospital process was carried out at Civil Hospital Mohali from March 5th to March 10th and the study of customization of HIS was carried out at the Implementers Office from March 15th to March 25th.

3.2 Data Collection Method:

- *Pre- implementation evaluation*: This study is a qualitative study which included 30 respondents. The tool used for data collection was questionnaire (Annexure 1) for interviews. The respondents of the study are the end users of the Hospital Information System i.e. nursing staff, Administrative staff, Medical Professionals, Technical Staff and Clerical Staff and Patients which were selected by random sampling.

- *Customization and testing of HIS* : This was a qualitative study for which the data was collected by reviewing various papers and manuals and also by hands on experience on customization & testing.

3.3 Data Analysis:

A. Pre- Implementation Evaluation of Processes in Civil Hospital, Mohali

In the first phase (planning and design) of the implementation a pre-implementation evaluation is done to know the process flows in the hospital and also to know the computer proficiency of the hospital staff so as to design the training plan accordingly. This pre-implementation assessment is helpful in problem diagnosis, designing, and reduction of uncertainty (Smithson & Hirschheim 1998). A pre-implementation study was carried out in Civil Hospital, Mohali to understand the outpatient and inpatient process flow of the hospital.

The various process flows were identified after the one-to-one interaction with the hospital staff. And after interacting with the patients the time for which the patient waited could be analyzed at the different steps of hospital processes. The study is divided into 2 parts which includes studying the OPD Processes and the IPD processes. The workflows of various departments of the hospital are as follows:

A.1 OPD Process Flow:

This includes:

- New Patient Registration
- Old Patient Registration
- Emergency Registration
- Consultation Process

New Patient Registration

OPD registration timings 8:00 AM to 2:00 PM

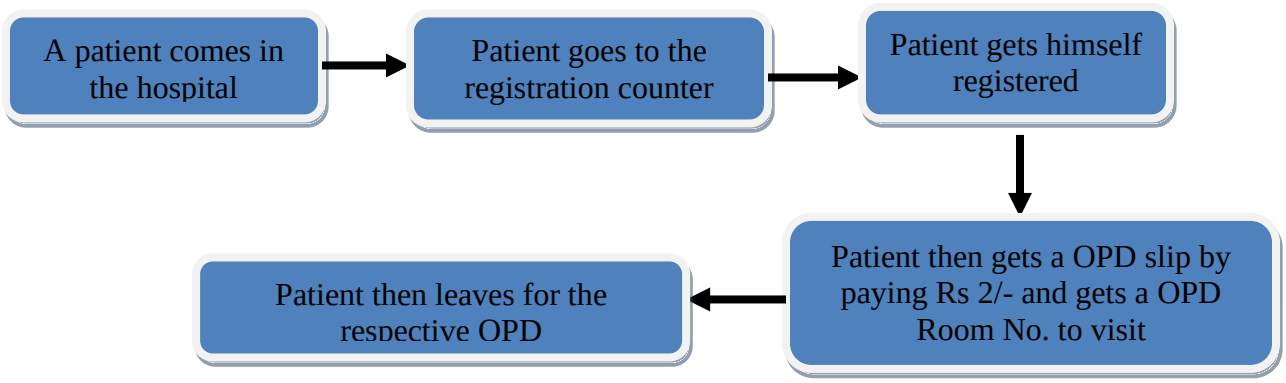

Figure 1: New Patient Registration Flowchart

After the discussion with the patients, for new patient's registration the waiting time is 30 minutes.

Old Patient Registration

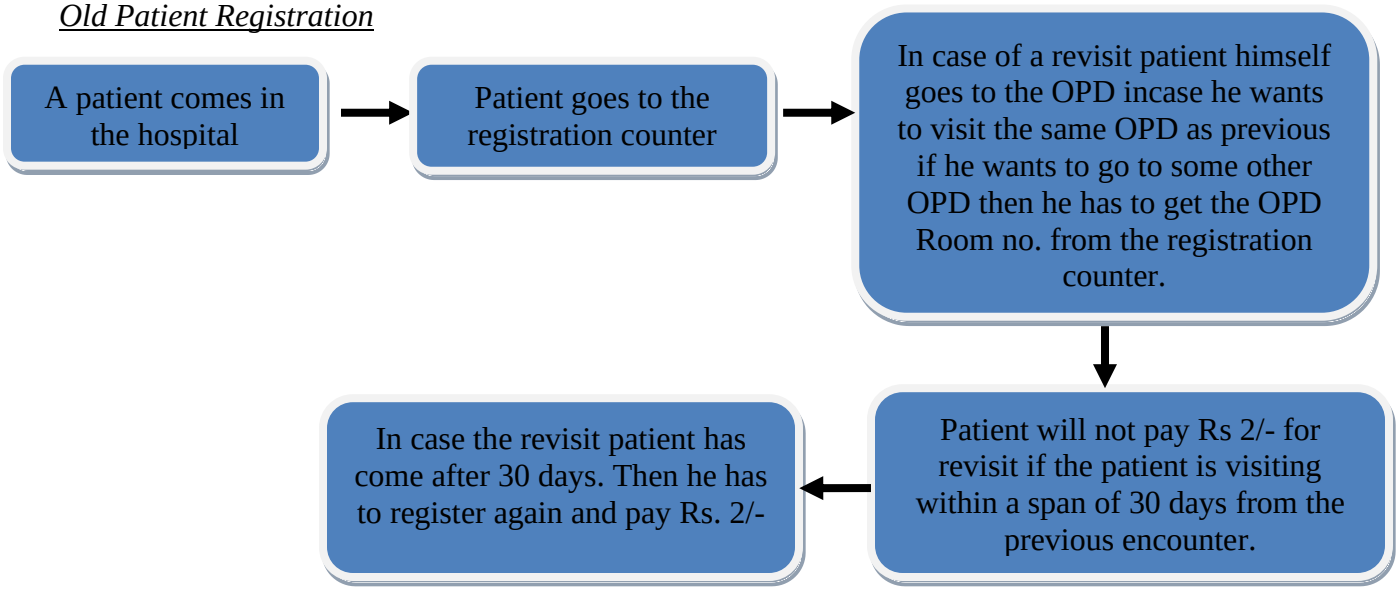

Figure 2: Old Patient Registration Flow chart

For revisit patients waiting time is of 15 minutes.

Emergency Patient Registration

Emergency Registration Timings: After 2:00 PM onwards.

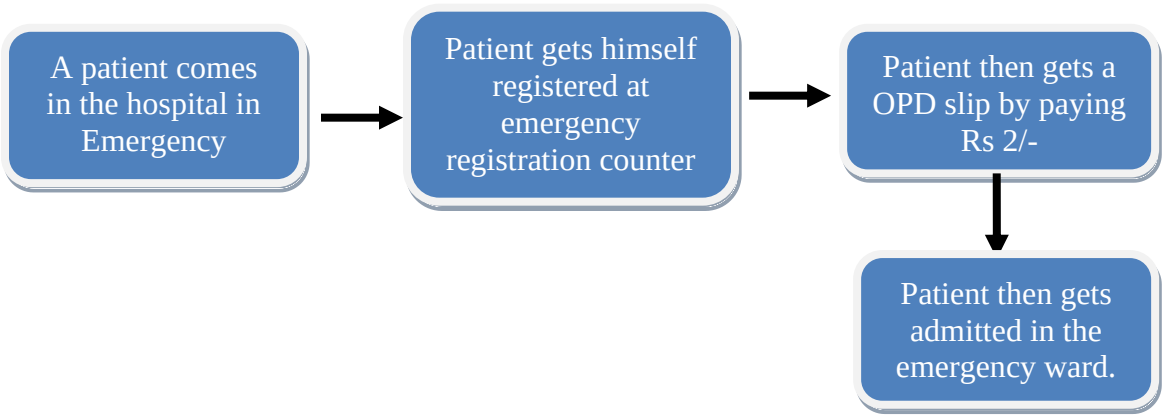

Figure 3: Emergency Registration Flow chart

And in case of emergency registration waiting time is of 15 minutes.

OPD Consultation Process

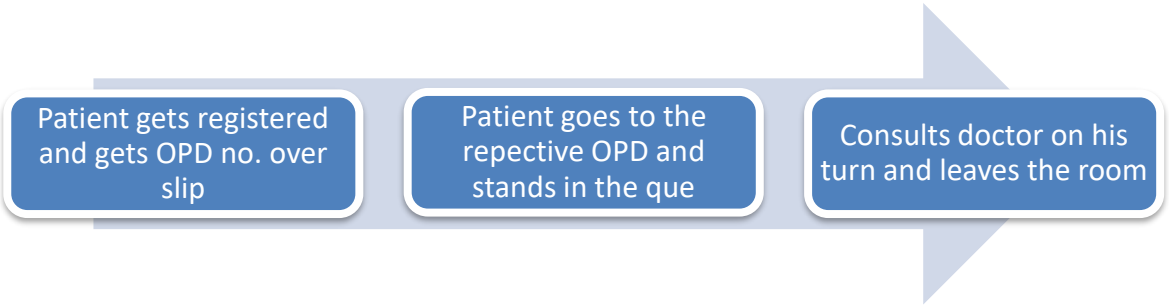

Figure 4: Out Patient Process Flowchart

After evaluation it was found that the patient had a waiting time of 30 minutes for the doctor's consultation.

A.2 IPD Process Flow

The IPD process includes:

- Admission
- Discharge Process
- Medication Administration Process

Admission Process

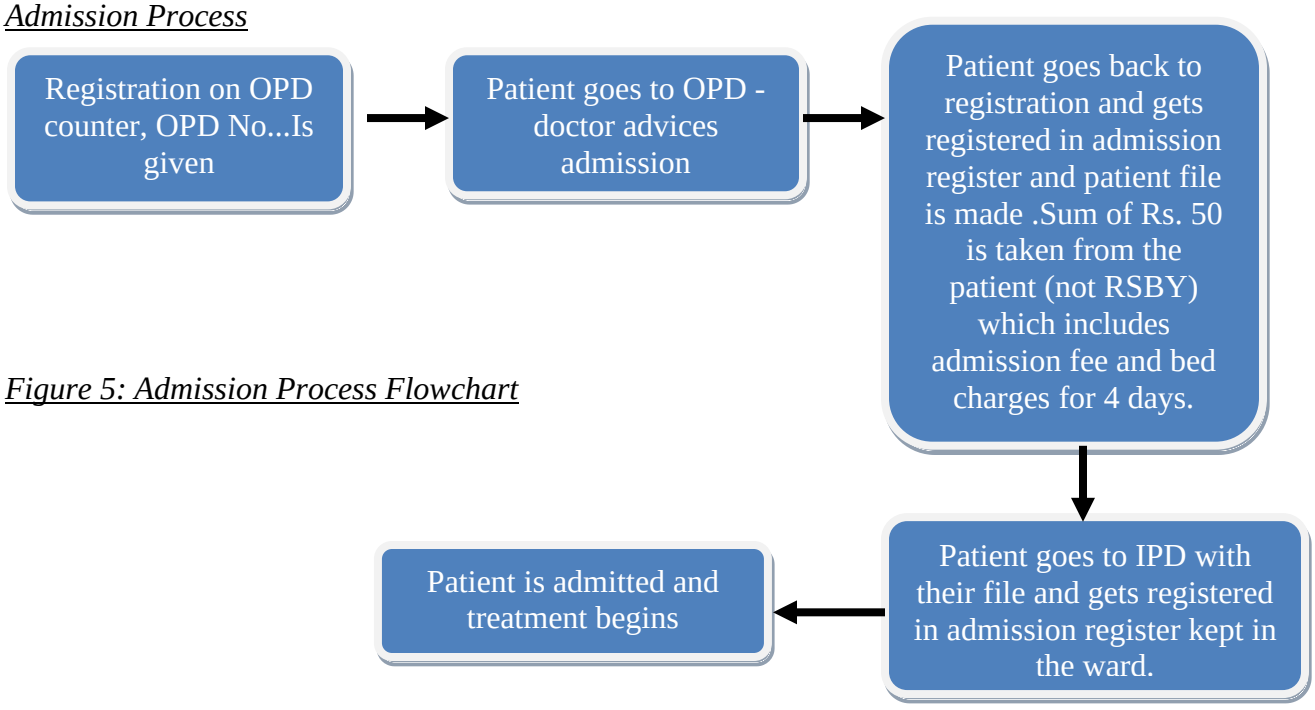

Figure 5: Admission Process Flowchart

The waiting time for the admission procedure is of 50 minutes. As first the patient has to go to the billing for the admission file and advance payment of the bed charges which takes around 30 minutes and then the patient goes to the particular ward where nurse gives the bed and takes the vitals of the patient which takes 20 minutes.

Discharge Process

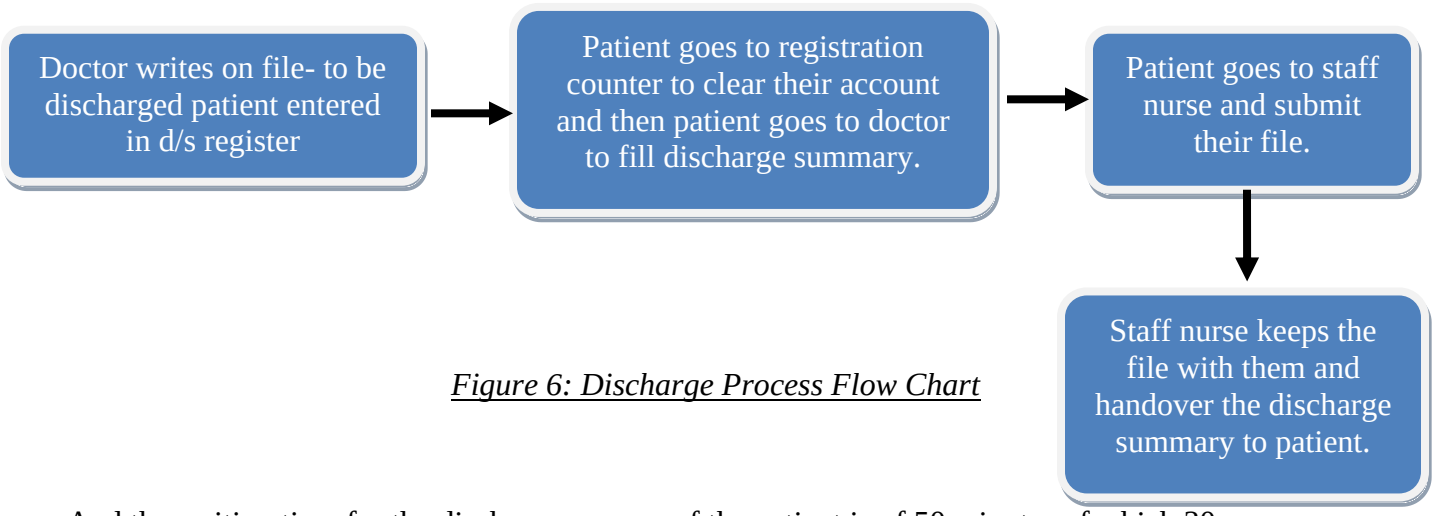

Figure 6: Discharge Process Flow Chart

And the waiting time for the discharge process of the patient is of 50 minutes of which 30 minutes for billing clearance and 20 minutes for discharge process by attending physician.

Medication administration Workflow:

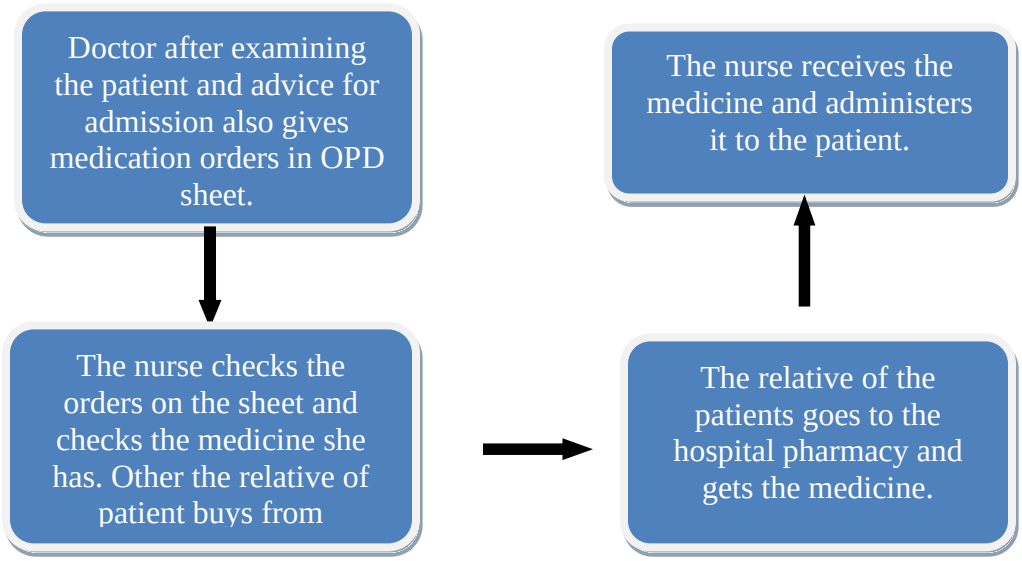

Figure 7: Medication Administration Flowchart

The time taken for medication administration on an average is about 40 minutes.

B. Customization of HIS for Civil Hospital, Mohali

The second phase in implementation of hospital information system includes implementing the reengineered solution including design, construction, testing, and subsequent. In the customization phase of the hospital information system the Technical team and the implementation team play a major role. The implementer's role in the customization phase starts after the technical team is done with their role. For the testing phase to start the customization by the implementers is to be done. The various parts of the customization done by the implementers include the following aspects:

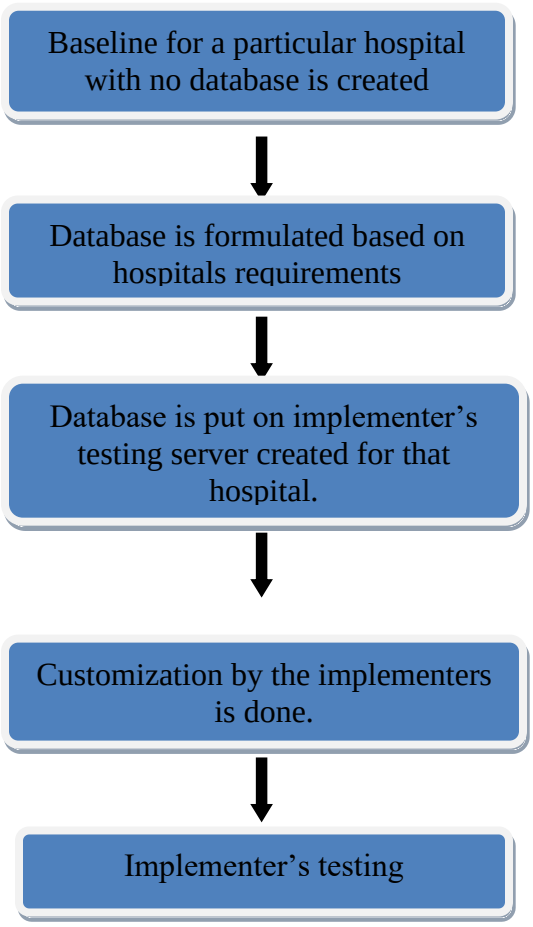

Figure 11: Process Flowchart for Customization

B.1 Database formation based on the hospital requirements:

Database is this HIS is known as Concept dictionary. The concept dictionary is the backbone of the Open Medical Records System (OpenMRS). It defines "the name, code, and appropriate attributes for any observations or data collected (including medical tests, drugs, results, symptoms and conditions)."1 It is also a "collection of coded, unique concepts used to generate forms and encode data within the system."2 Every medical concept that will be used in the electronic health record system must be defined within the dictionary.

Formation of a database for a HIS includes various aspects:

- Diagnosis
- Procedures – Minor and Major Procedure's
- Drugs list
- Referencing of ICD-10 and SNOMED-CT
- Laboratory and Radiological Investigations
- Billable Services like Medical examination, Ambulance, License Fees etc….

In this HIS the database contains the following fields which are to be filled for forming a concept in the database.

- Primary Name

  The primary name is the name by which that concept would be searched for. This could be name of diagnosis, laboratory tests, radiological investigation, procedures, drugs etc…

  - The name should be completely specific. It is HEPATITIS B IMMUNIZATION, not IMMUNIZATION, HEPATITIS B.
  - Use all CAPITALS
  - Use only alphanumeric characters! (If this was a concept, there would be no exclamation point.)
  - NO ACRONYMS: Abbreviations and acronyms are only used as synonyms!!
  - When necessary, always refer to the generic form, e.g. Ibuprofen, not Advil©

- When referring to organism or virus, the full taxonomic name is used, e.g. HUMAN IMMUNODEFICIENCY VIRUS, not HIV
- Adhere to complete granularity! RIGHT UPPER QUADRANT ABDOMINAL PAIN refers to too many observations. This can be tricky in practice and if you're unsure, refer to a geek or someone who can identify mini-clauses within your proposed primary name.

- Short Name
  - Be smart and only use alphanumeric characters, avoid long phrases, and acronyms that may have several meanings

- Synonym
  - Again, be smart! Use any other phrases or acronyms that people within your organization may search for when attempting to use this concept. If you're at a loss, conduct a survey of possible end users.

- Description
  - Without question, at the end of reading this statement, a lay person should have a decent idea of the concept meaning. This is always REQUIRED, no exceptions.

- Concept Class - The classification of a concept. This classification details how a concept will be represented (i.e. as a question or an answer). The current list of classes includes:
  - Test – lab tests (e.g. CD4 Count) or physical exam maneuver (e.g. Babinski)
  - Procedure – spinal tap, lumbar puncture, etc.
  - Drug – medications, prescriptions and over the counter
  - Diagnosis – defined medical conclusion (usually in ICD), e.g. diabetes, AIDS
  - Finding – physical or exam findings (shortness of breath, systolic murmur, LLL infiltrate)
  - Anatomy – body part, e.g. right arm, frontal love, and abdomen.
  - Question - query to which there are either open-ended or coded responses
  - LabSet – a group of several test concepts, e.g. I-Stat Chem8+

 MedSet – a group of several medications, e.g. cardiac medication

 ConvSet – a group of concepts, typically questions, assembled for convenience, e.g. vitals signs

 Misc – unclassifiable concepts, typically general descriptions of location or rankings, e.g. left, severe, positive

 Symptom – any sign or indication of a possible conclusion, e.g. chills, increased heart rate.

 Symptom/Finding – any sign or indication, not specifically linked to one conclusion

 Specimen – a sample of any larger part, e.g. tissue, blood sample

 Misc Order – orders typically not utilized by the organization

 Program – a specific plan, or set of plans, that a patient may be enrolled in, e.g. first line TB treatment

 Workflow – a process, as described by the organization

 State – a general description of a patient or body's status, e.g. comatose

- *Concept Data type* – The structured format you desired the data to be represented as. The current types are as follows:

  Numeric – any data represented numerically, also allows you to classify critical values and units, e.g. age, height, and litres consumed per day.

  Coded – allows answers to be only those provided, e.g. Blood type can only be "A," "B," and "O"

  Text – Open ended responses

  N/A –the standard data type for any non-query-like concepts, e.g. symptoms, diagnoses, findings, anatomy, misc, etc.

  Document

  Date – structured day, month, and year

  Time – structured time response

  Date Time – structured response including both the date and the time

  Boolean – checkbox response, e.g. yes or no queries

  Rule – rule-based response

 Structured – Complex numeric values possible (i.e., <5, 1-10, etc.)

- Version – A method to keep track of the number of updates applied to a specific concept.

Creating a New Concept in HIS Concept Dictionary

The creation of a new concept is usually done by domain experts. A domain expert "is a person with special knowledge or skills in a particular area of endeavor.

There are many things to consider when creating a database for HIS:

First and foremost: Language. Depending on what country you're in, what version of English is used as the medium of instruction, one must choose the language for the database. In India, we use British English as the spoken English, and also as the medium of instruction for education. Therefore the baseline concepts are created in British English, with American English as synonyms (e.g.: diarrhea vs. diarrhea, edema vs. edema)

No use of duplicates, as they disturb the functioning of the modules. On previous versions of HIS, it was possible to create duplicates, however on HIS Version 1.8, duplicate concepts cannot be created

Some concepts have been hard-coded**,** so do not disturb these (e.g. **'Global Obs')**

Conventions: what kinds of conventions:

a) Other than the hardcoded concepts that are in upper case and lower case both, all the other concepts are in UPPER CASE
b) All vaccines are mapped to a single vaccine concept (e.g. all vaccines related to polio vaccine will be mapped to polio vaccine concept in dictionary)

References:

ICD-10: International Statistical Classification of Diseases and Related Health Problems 10th Revision. The ICD is the international standard diagnostic classification for all general epidemiological, many health management purposes and clinical use. These include the analysis of the general health situation of population groups and monitoring of the incidence and prevalence of diseases and other health problems in relation to other variables such as the characteristics and circumstances of the individuals affected, reimbursement, resource allocation, quality and guidelines.

It is used to classify diseases and other health problems recorded on many types of health and vital records including death certificates and health records. In addition to enabling the storage and retrieval of diagnostic information for clinical, epidemiological and quality purposes, these records also provide the basis for the compilation of national mortality and morbidity statistics by WHO Member States. (Reference: http://www.who.int/classifications/icd/en/)

Work on creation of ICD-10 began in 1983 and was completed in the year 1992

SNOMED CT – the Systematized Nomenclature of Medicine Clinical Terms - is a comprehensive and precise clinical reference terminology designed to make healthcare information useable and accessible. Global in scope SNOMED CT provides a common language of great depth that enables a consistent way of capturing, sharing and aggregating health data across clinical specialties and sites of care. (http://snomed.dataline.co.uk)

Thus, as is evident from the description, both ICD-10 and Snomed provide a systemic universal classification of diseases. Thus the diagnoses made using OpenMRS in the hospital can also follow universal conventions. There are however, exceptions to this use. If there is a colloquial term used by doctors, or if doctors do not wish for such specificity in their diagnoses (granularity), a more common, collective term can be used. Example: Just 'Carcinoma' may be used instead of D01 Carcinoma in situ of other and unspecified digestive organs, D02: Carcinoma in situ of middle ear and respiratory system etc. (According to the 10th revision, that is, ICD-10), if the doctor does not wish for such specific nature of the diagnosis. So depending on the size of the hospital, granularity is selected. For a Medical College and Hospital, such specific details may be required, while for an FRU, such granularity may not be required.

Nomenclature: In case of disease conditions that have acute and chronic state, the word acute or chronic is used first, followed by the disease condition (ex: Acute Sinusitis, Chronic Sinusitis)

Drugs:

Drug nomenclature differs in different parts on the world, based on the pharmacopoeia that is used. Indian drug industry follows the Indian pharmacopoeia, whereas there are other pharmacopoeia that are also used like US and British (USP and BP). The reference used is CIMS (Current Index of Medical Specialties). This reference lists drugs in their generic salts forms, and also provides brand names containing that generic salt as an active ingredient. In OpenMRS

dictionary, we use the generic salt as the concept name, and do not add any brand name (ex: We add the antiretroviral Zidovudine as concept and not its brand name Retrovir). If there are different salts of the same generic drug molecule that have the same pharmacological properties, these are included as synonym concepts. However, if a different salt has different pharmacological properties and therefore different indication in therapy, then it is listed as a separate concept.

Steps:

1. Log in to your OpenMRS installation.

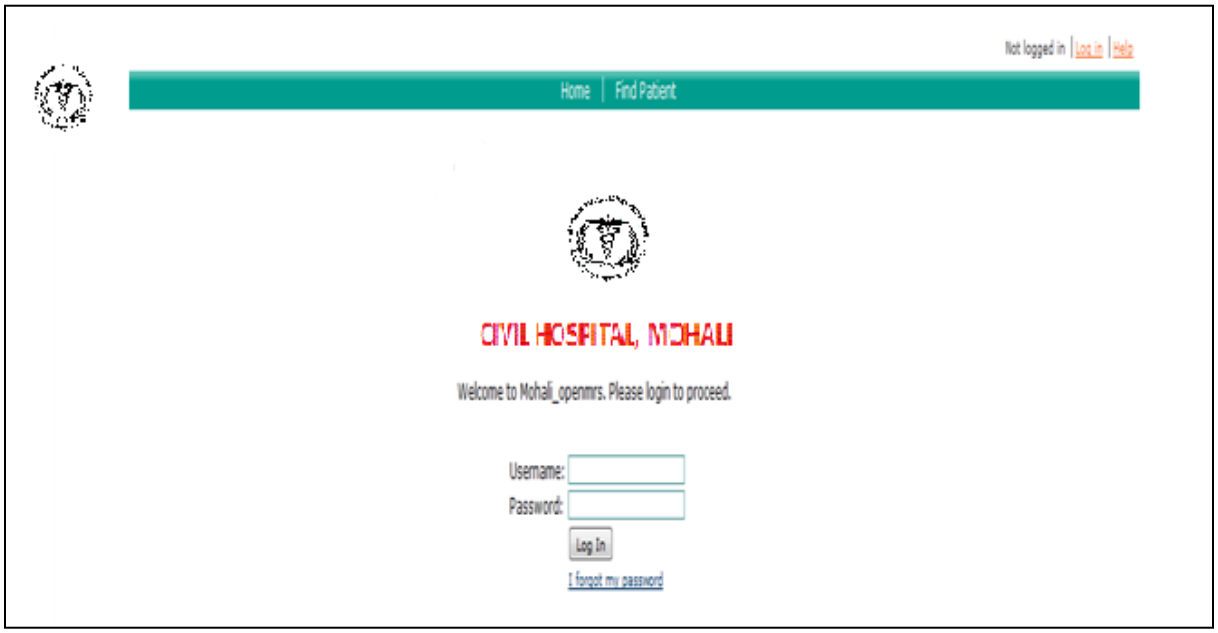

Figure 12: HIS Log in page.

2. Click “Dictionary” in the main tab.

Figure 13:OpenMRS Main page after a logging in.

3. Click “Add New Concept”

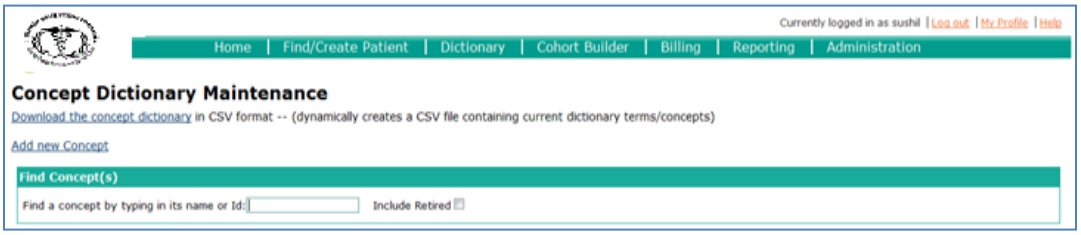

Figure 14: Webpage after clicking the main Dictionary tab.

4. Following table in Appendix A, encode the necessary properties, attributes of the

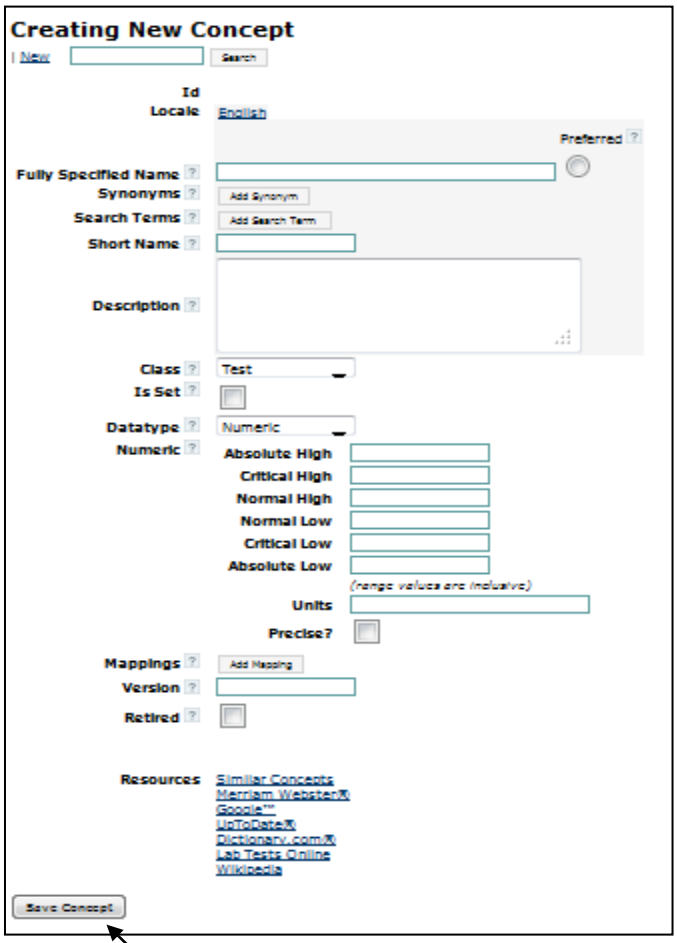

Figure 15: Creating New Concept page.

5. Click “Save Concept” and continue to the next new concept.

B.2 Customization based on the hospital requirements:

B.2.1 Role and User development

- HIS uses roles to manage permissions. Typical roles include:
  - system administrator - configures Open MRS, installs and updates modules, manage user accounts
  - registrars - adds new patients to Open MRS at check-in; adds patients to programs
  - data entry clerk - creates and updates encounters after a visit
  - care providers - views patient records at point of care; creates or updates orders or encounters; assigns regimens
  - content editors - creates or updates the forms that collect encounter data; adds or changes concepts in the concept dictionary; adds or updates programs

- Steps for Adding Users:

  i. To add a user, log into HIS as an administrator and click on the "Administration" menu

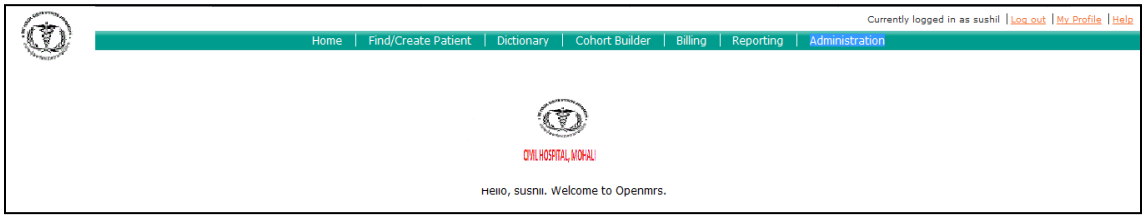

Figure 16: Welcome screen for administrator

  ii. From there, you will see a list of options. Click on "Manage Users"

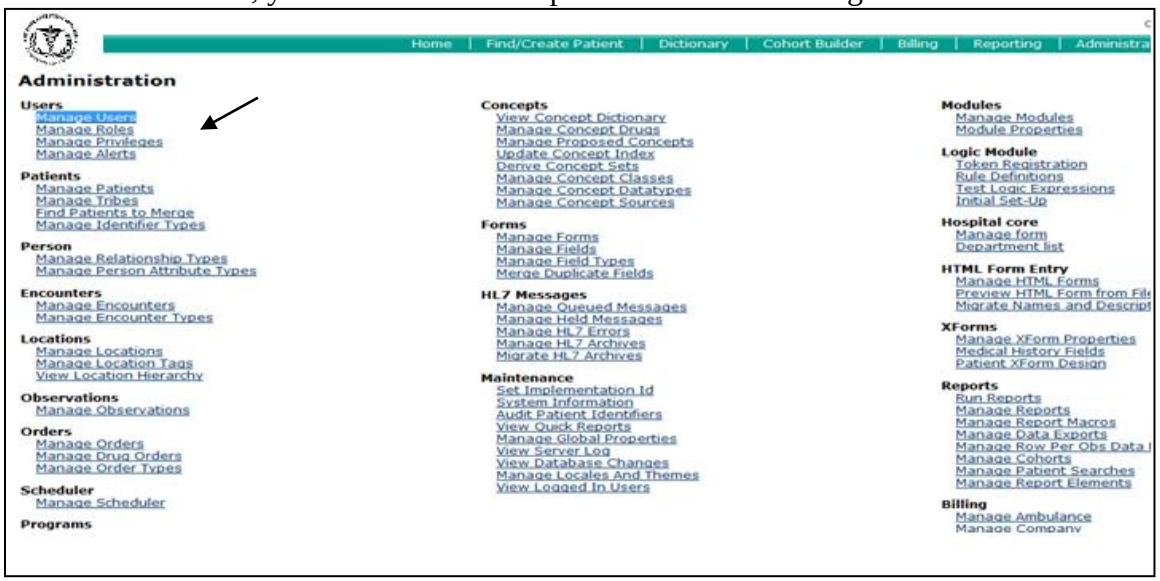

Figure 17: Administration Screen

Figure 18: User Management Screen

iii. Click on "Add User"

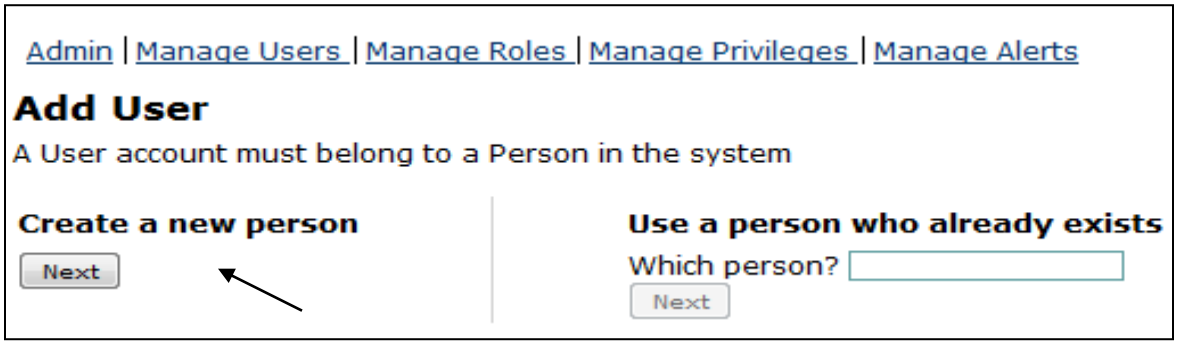

Figure 19: Add/ Search User Screen

iv. Click on the "Next" button under "Create a new person"

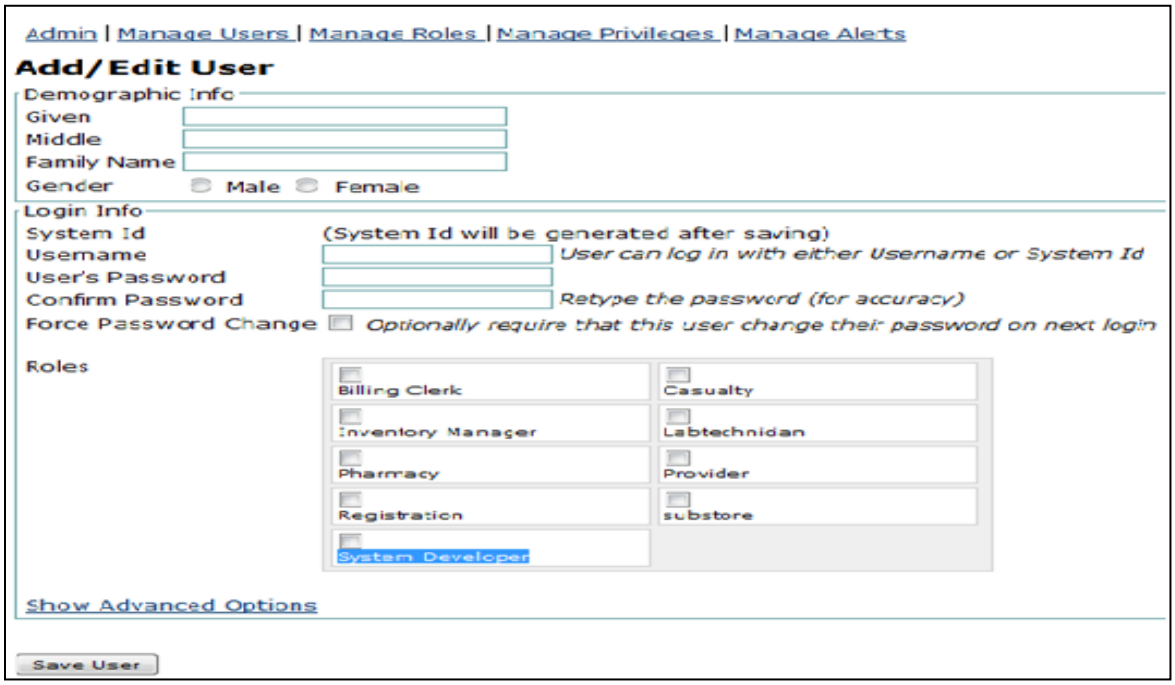

Figure 20: Crete / Edit User Screen

v. Type in the name of the person and the person's gender

vi. Set up a username and password for the person

The password has to be at least 8 characters long

The password has to have uppercase, lowercase, and at least one number

vii. Select a Role for the person

viii. Click on "Save User" button to add the person

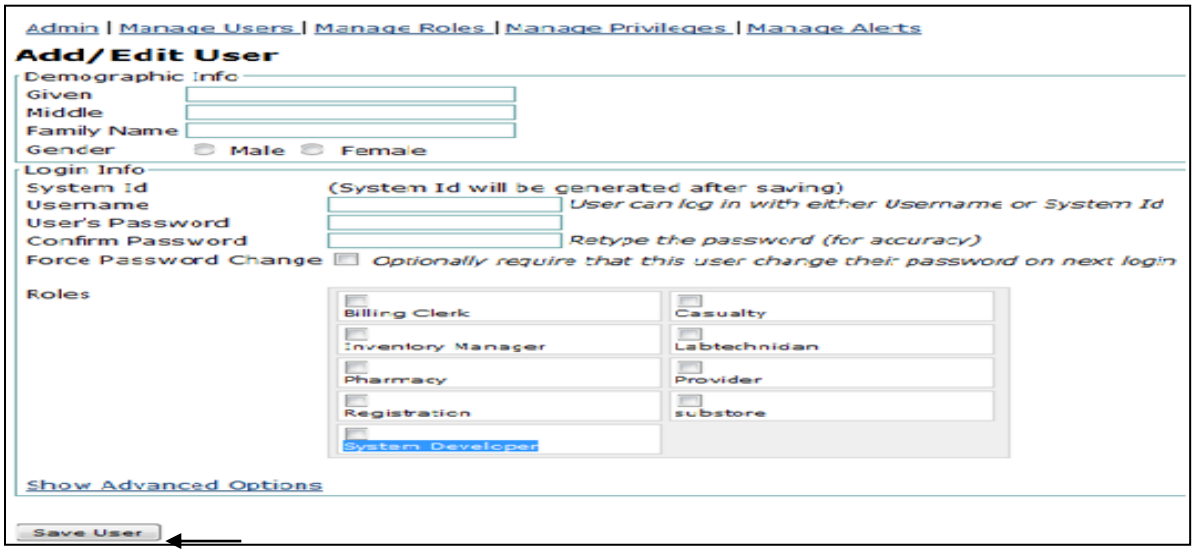

Figure 21: Save User

B.2.2 Module's Customization

i. ***Registration Module***

In this section the customization part includes Managing the person attributes i.e. adding the fields which are to appear on the registration screen of HIS like Father name/Husband name, patient category- the different categories of the patient are to be added like BPL, RSBY, Punjab Government employee, pensioner etc.., relative name, phone number.

Manage Person Attribute

Go to **Adminstration** option displayed on the main tool bar of the screen and select Manage Person Attributes.

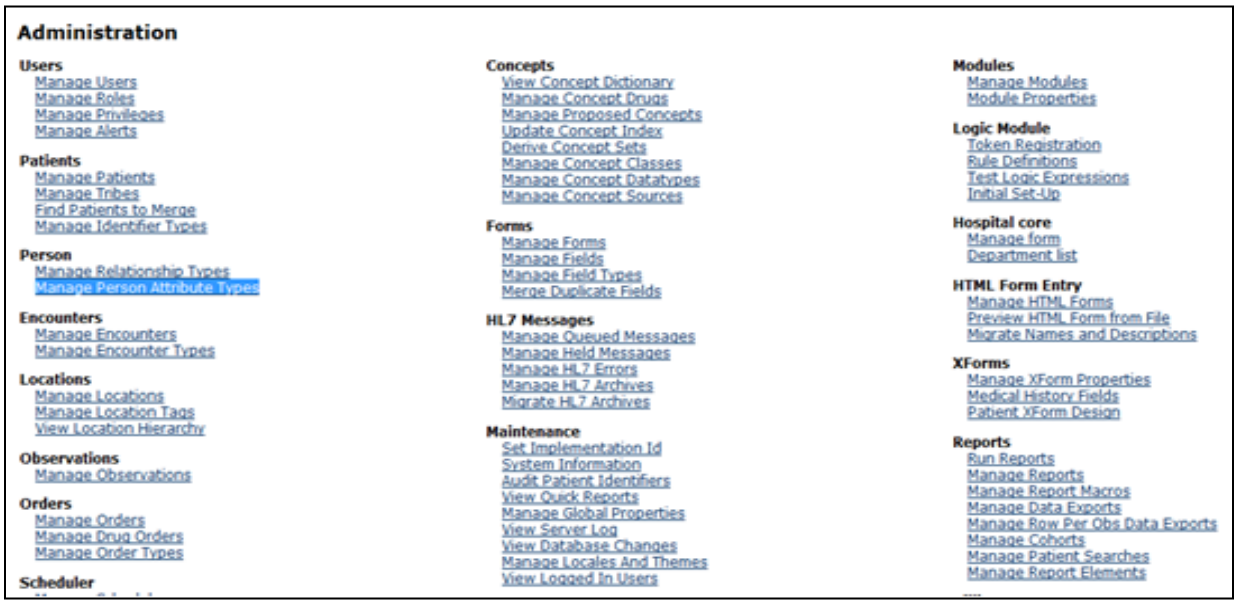

Figure 22: Administration Screen for Manage Person Attributes

On Clicking Manage Person Attributes Types the following window appears.

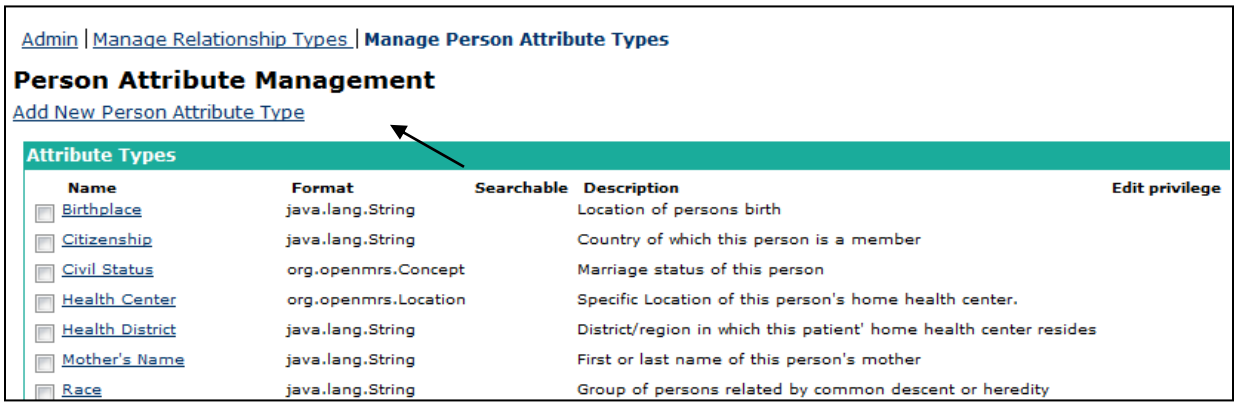

Figure 23: Person Attribute Management Screen

To Add New Person Attribute click on it and the following window appear.

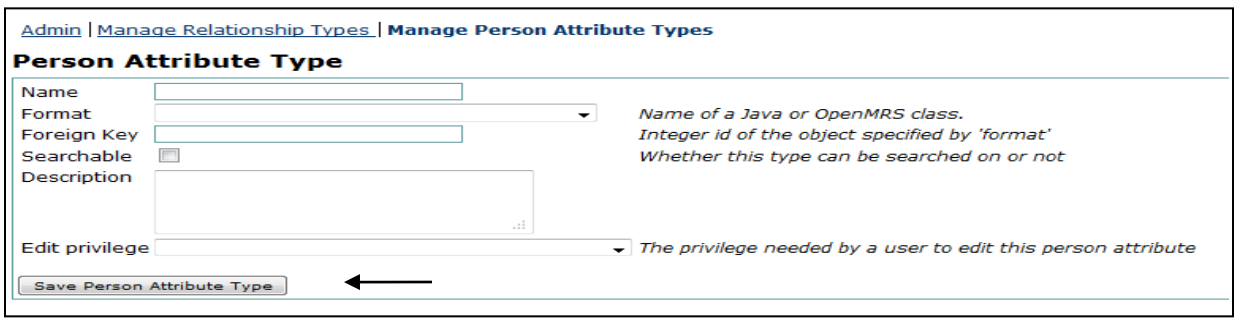

Figure 24: Add new Person Attribute.

Fill the fields and click on Save Person Attributes.

The Field definitions in the above screen are as follows:

- Name: Any string you want to recognize this type by. Spaces should not be used
- Format: Most likely it will be java.lang.String. Other possibilities are org.openmrs.User, org.openmrs.Concept, and org.openmrs.util.AttributableDate (version 1.4)
- Foreign Key: The only time a foreign key value is needed is when you are using a separate table for the answers. A good example of this is the Civil Status attr that links to the concept civil status for its possible answers.
- Searchable: Whether or not this attribute is included in searches
- Description: Text blob describing this type

ii. Billing Module

The customization of the billing module includes-

- Ambulances
- Companies
- Billable Services
- Tenders
- Miscellaneous Services
- Drivers

- **Manage ambulance**:

This functionality helps to view, add and remove Ambulances. Go to **Adminstration** option displayed on the main tool bar of the screen and click on the **Manage Ambulance** option listed under Billing.

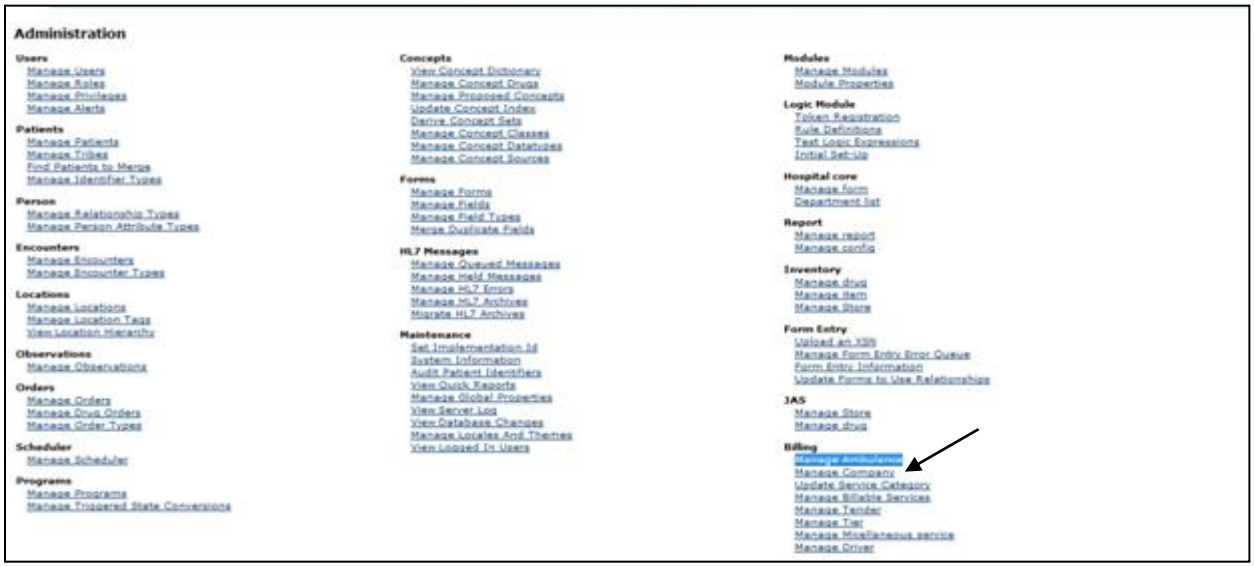

Figure 25: Administration Screen for Billing

The following window will appear

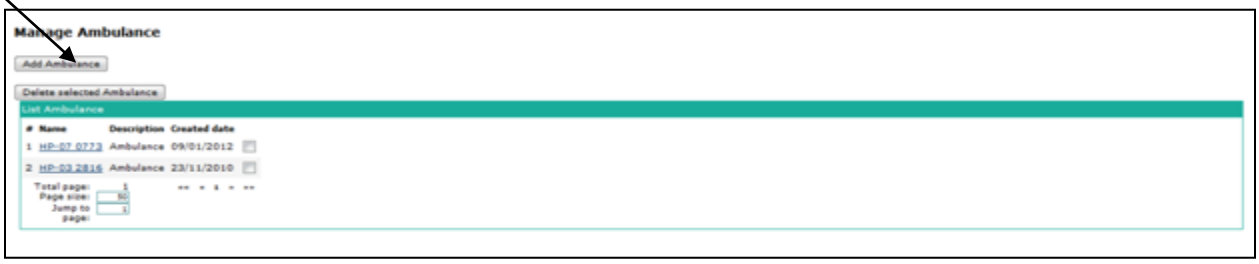

Figure 26 : Manage Ambulance Screen

The list of current Ambulances will be displayed, to add an ambulance you need to click on the add ambulance tab

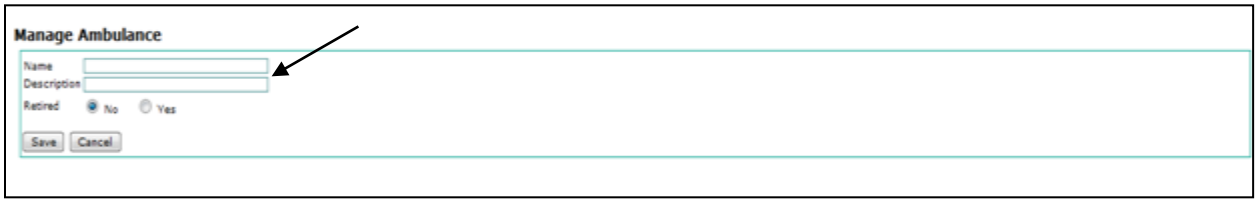

Figure 27: Add Ambulance Screen

Enter the name and description of the Ambulance that you need to add as shown in the window below:

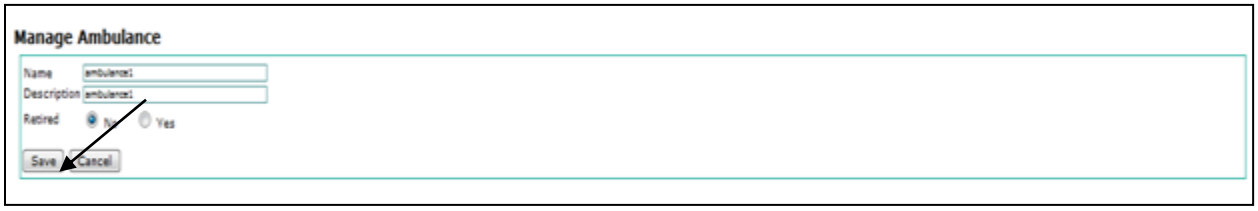

Figure 28: Save Ambulance Screen

Then click on **Save tab**. The Ambulance will appear on the window of Manage Ambulance after saving as shown in the window below:

Figure 29: List of Ambulance Added Screen

By selecting the name of the ambulance the user can edit the name and description of the ambulance and then you save it. If you have to delete an ambulance, then **click on the check box** and press the **Delete Selected Ambulance** Tab.

Figure 30:Delete Selected Ambulance

After that Ambulance will disappear from the list of Manage Ambulance as shown in the window below and it will show the **"Ambulance Deleted**" note on the top of the screen:

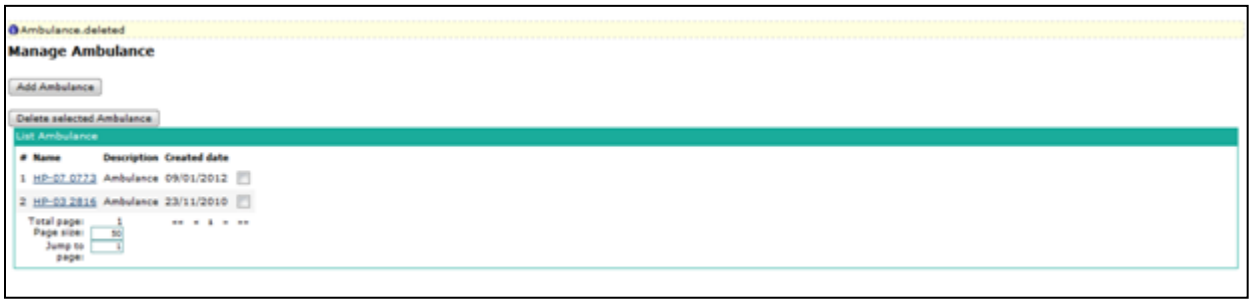

Figure 31: Ambulance Deleted

- **Manage company:**

This functionality helps to view, add and remove Company. Go to **Adminstration** option displayed on the main tool bar of the screen and click on the **Manage Company** option listed under Billing

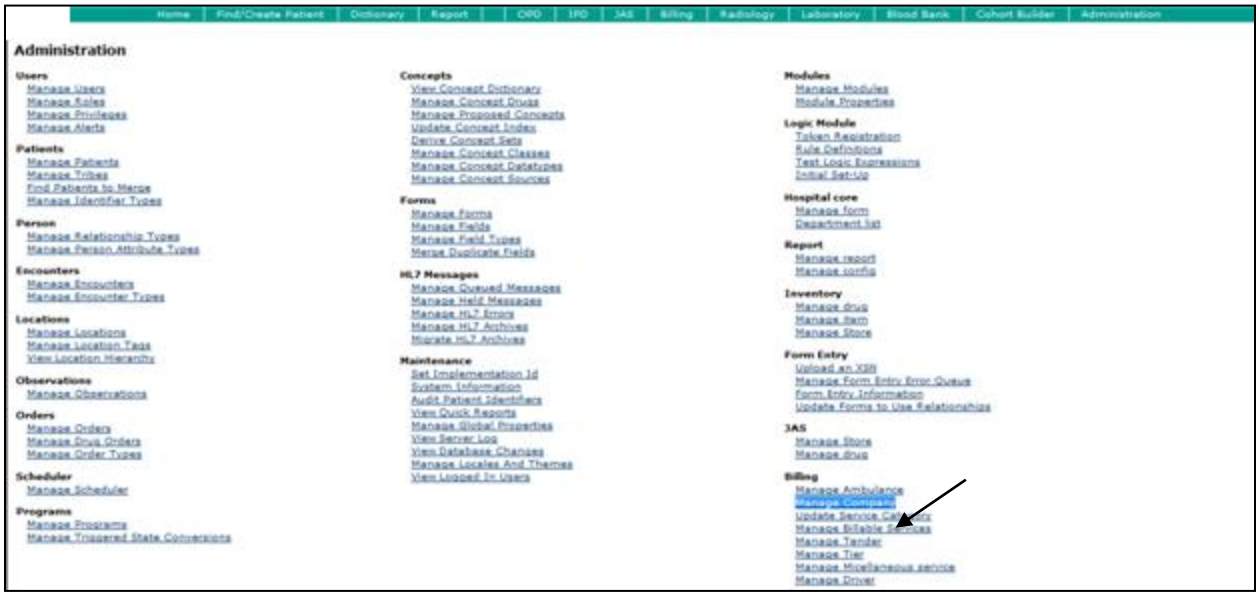

Figure 32: Administration Screen for Manage Company

The following window will appear

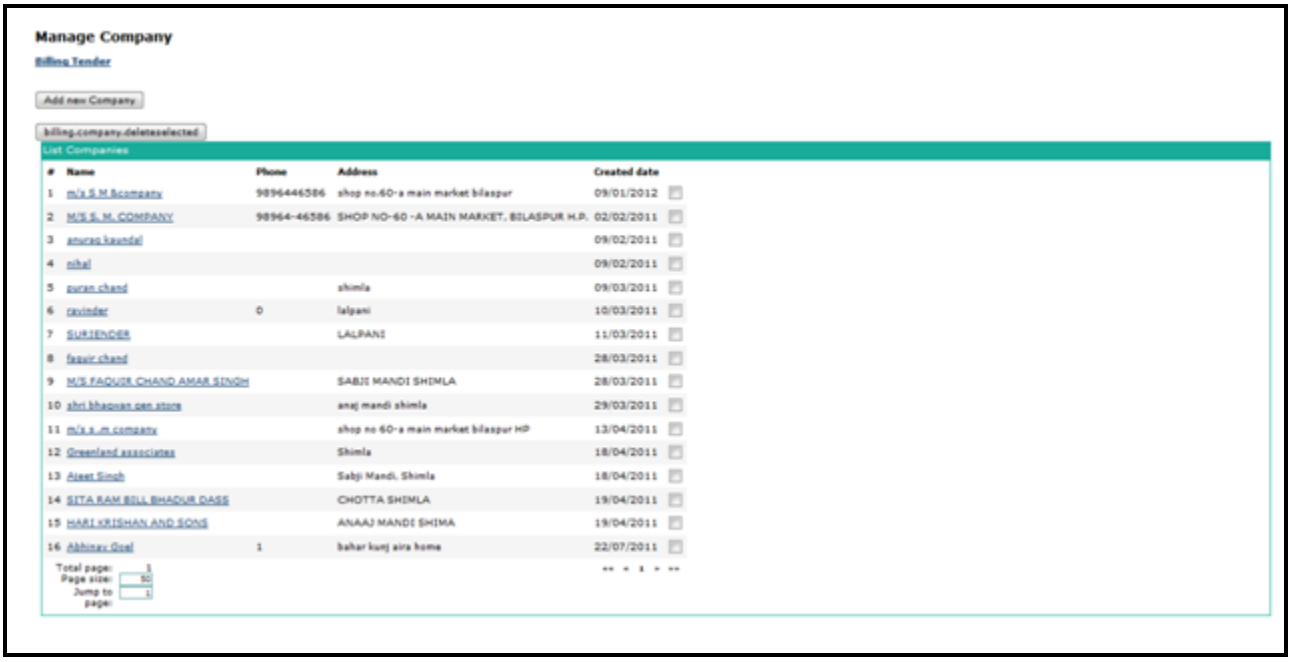

Figure 33: Manage Company Screen

All the list of current companies will be displayed, by selecting the name of the company user can edit the name and description of the company and then user have to save it

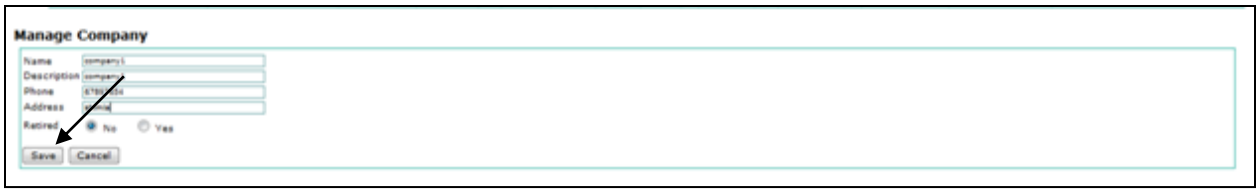

Figure 34: Add new Company Screen

Then click on **Save tab.** The Company will appear on the window of Manage Company after saving as shown in the window below:

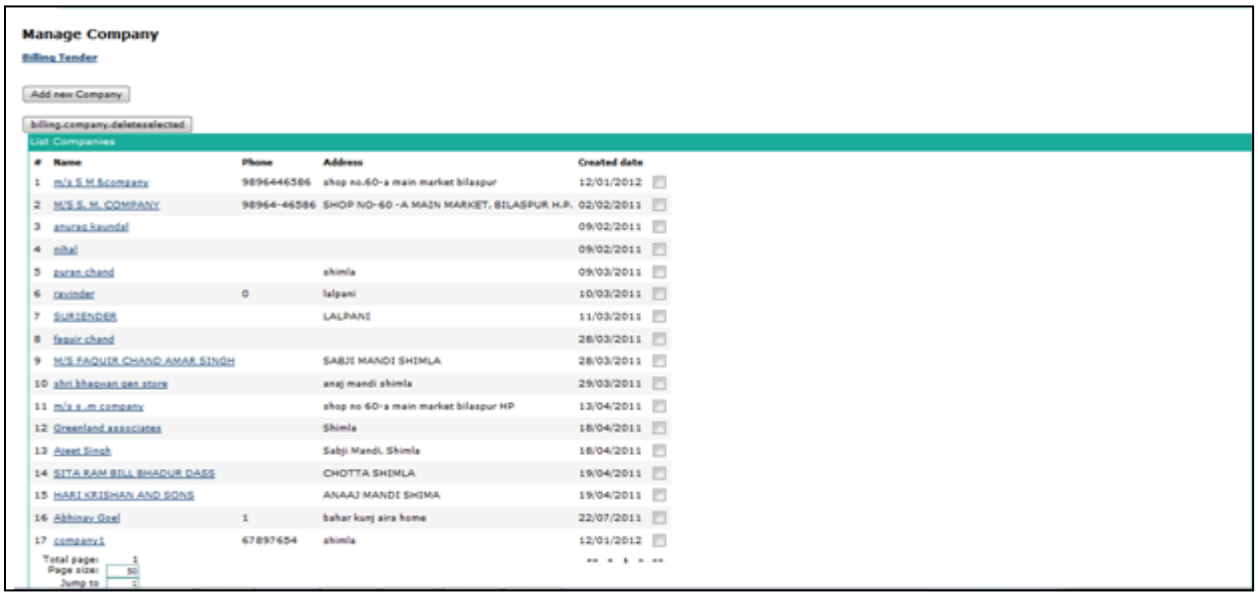

Figure 35: List of Company added Screen

By selecting the name of the company user can edit the name and description of the company and then user have to save it.

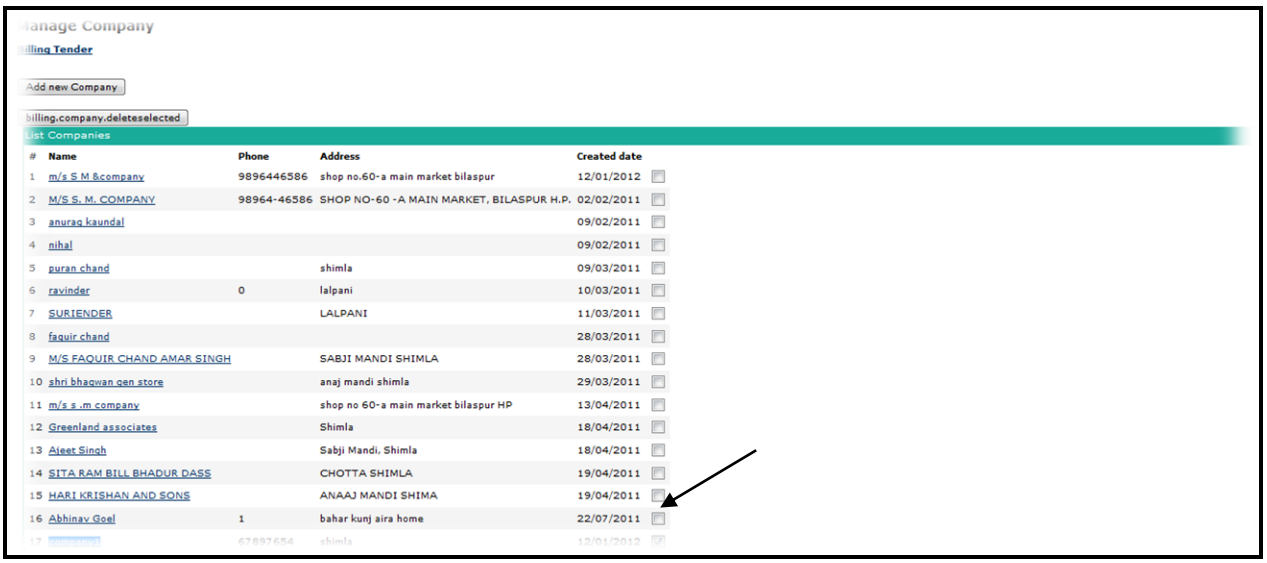

Figure 36: Edit Company Process

To delete the company user have to click in the box which is after created date, and then user have to click on the delete selected companies tab. After that company will disappear on the window of Manage Company as shown in the window below and it will show the note on the top of the screen.

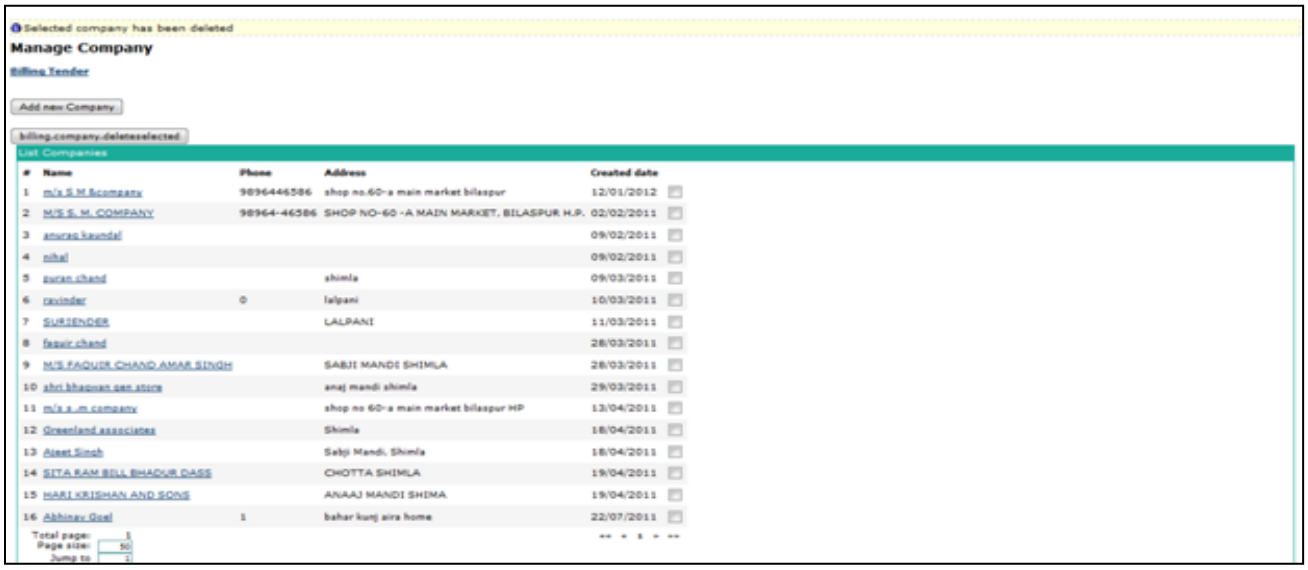

Figure 37: Delete Company

Update service category

Update Service category is an Important Functionality. Whenever we add a new service Like Ambulance, Tender, Company Driver of make changes in the billable services for which a user charge is levied it is important to Update Service category.

Go to **Adminstration** option displayed on the main tool bar of the screen and click on the **Update Service Category (**it will update all service categories under respective tables in the Data base), listed Under Billing as Shown Below

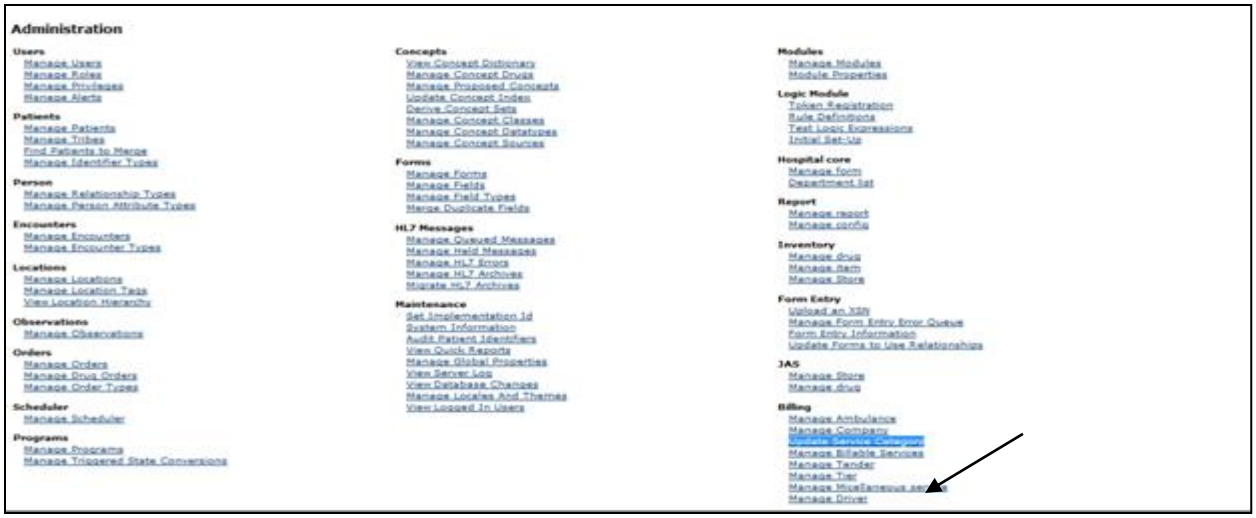

Figure 38: Administration Screen for Update Service Category

- **Manage Billable Service.**

This functionality helps to add prices to Investigations/Diagnostics .To add Prices go to **Adminstration** option displayed main tool bar of the screen and click on the **Manage Billable Service option** listed under Billing. The following Window appears.

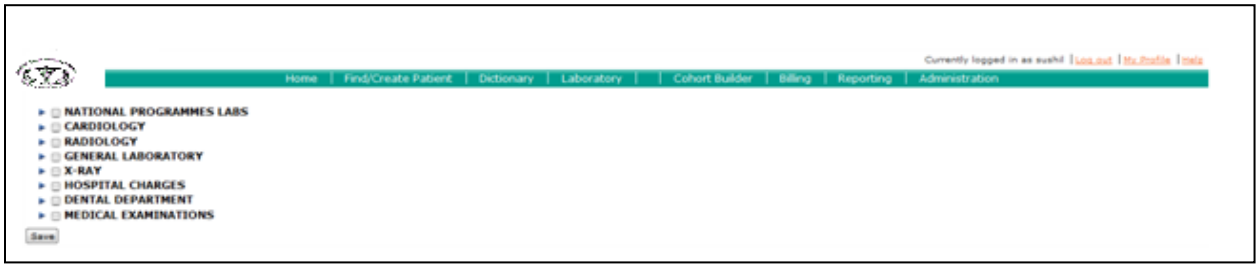

Figure 39: Manage Billable Services Screen

Now click on the arrow Near the Investigation Name (Dental Department) and a Drop Down of procedures under Dental Department available in the Hospital appear. Now enter a Price for the procedure and press the same button.

Figure 40: Billing Hierarchy

- **Manage tender:**

This functionality helps to view, add and remove Tender. Go to **Adminstration** option displayed on the main tool bar of the screen and click on the **Manage Tender** option listed under Billing.

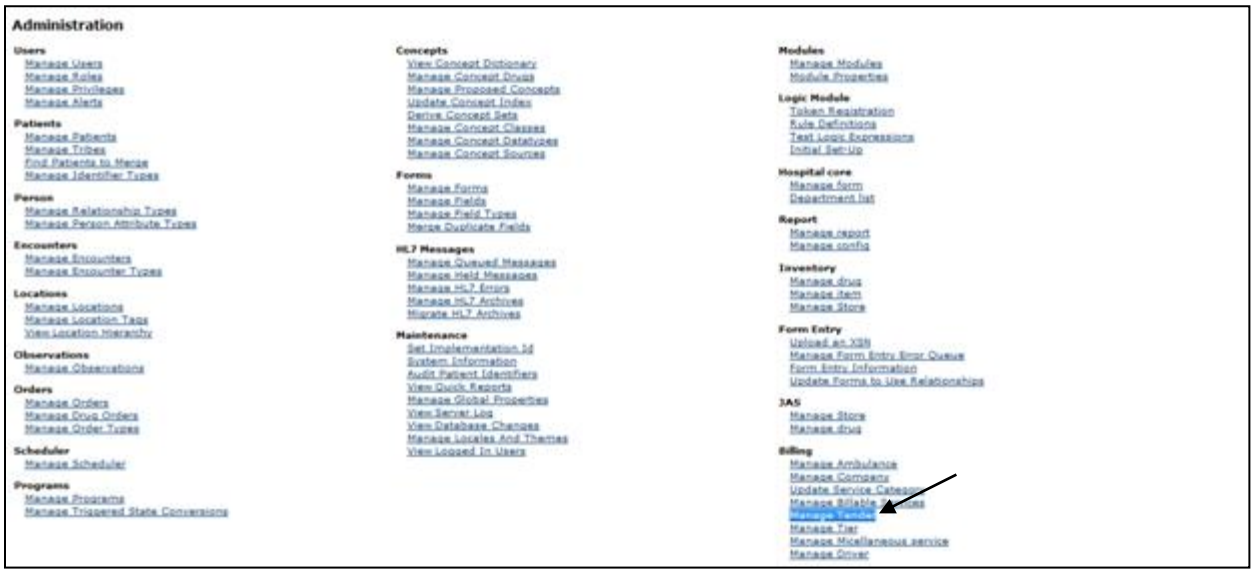

Figure 41: Administration Screen for Manage Tenders

The following window will appear

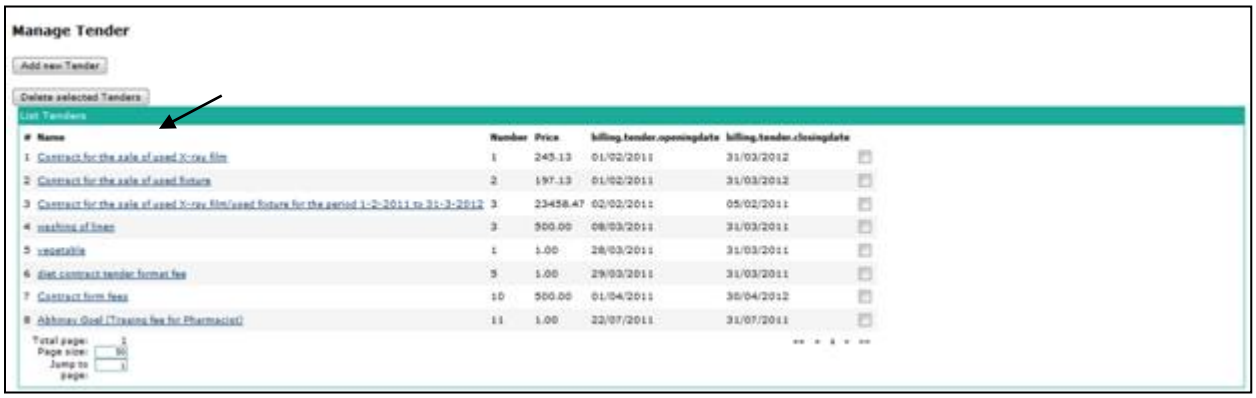

Figure 42: Manage Tender Screen

All the list of current companies will be displayed
To add new Tender user will click on the Add new Tender tab

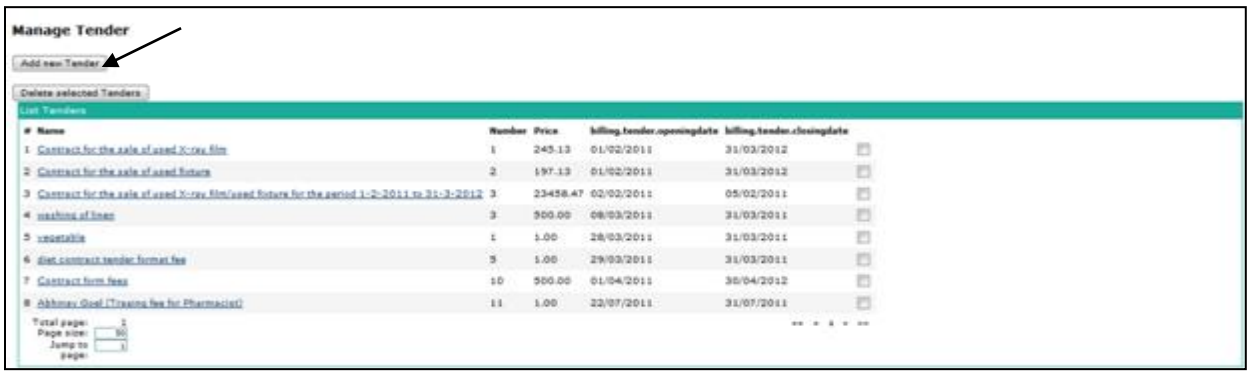

Figure 43 : Add new Tender

The following window will appear

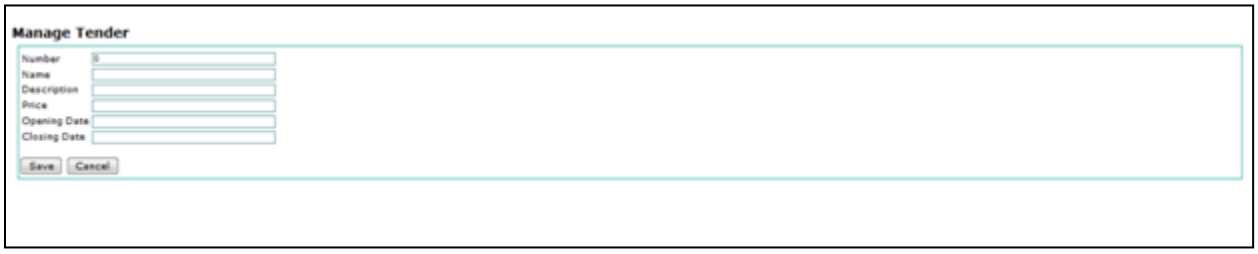

Figure 44: Add new tender form

User has to enter the details of tender that you need to add as shown below

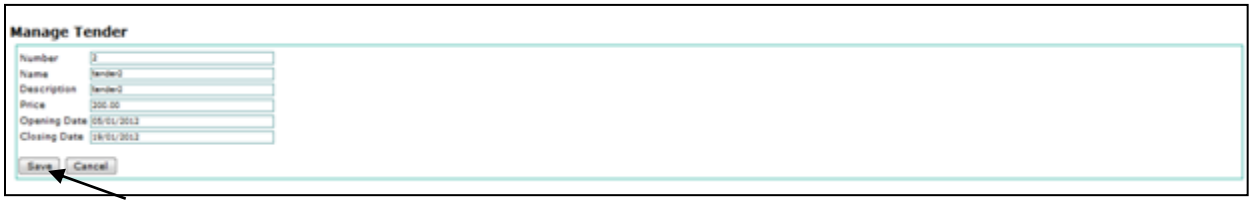

Figure 45: Save Tender form

Then click on **Save tab.** The Tender will appear on the window of Manage Tender after saving as shown in the window below

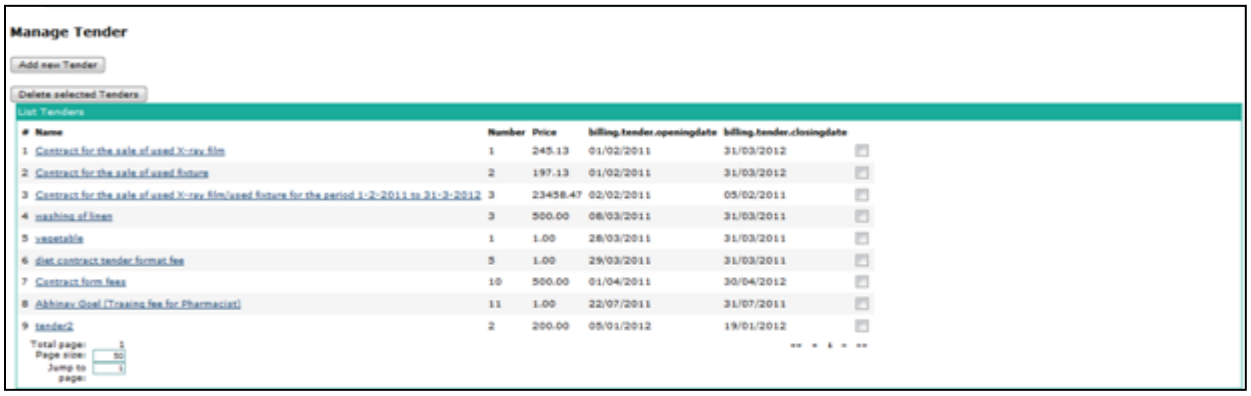

Figure 46: Tender Lists

To delete the Tender user have to click in the box which is after created date, and then user have to click on the delete selected Tenders tab

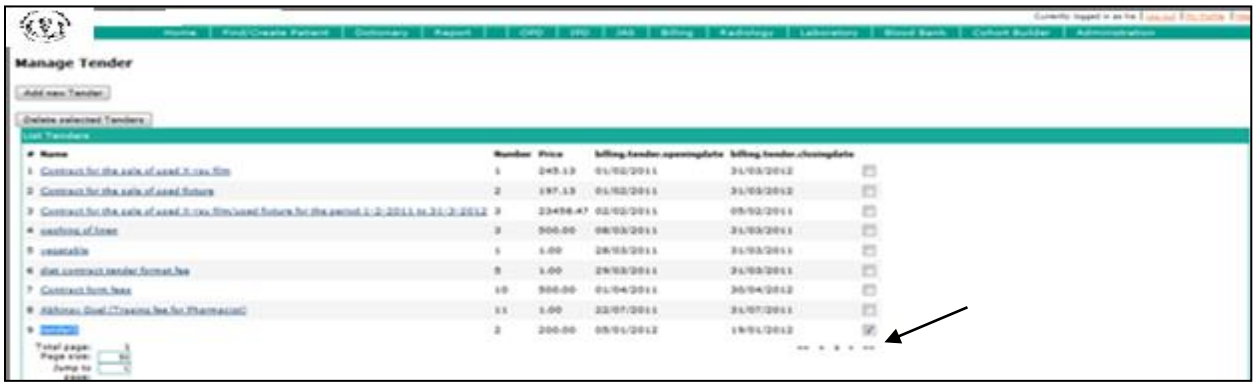

Figure 47: Delete Tender Category

After that company will disappear on the window of Manage Company as shown in the window below and it will show the note on the top of the screen

Figure 48: Tender list after deleting tender category

- **Manage miscellaneous services:**

This functionality helps to view, add and miscellaneous services. Go to **Adminstration** option displayed on the main tool bar of the screen and click on the **Manage miscellaneous services** option listed under Billing

Figure 49: Administration Screen fo Manage Miscellaneous Services

The following window will appear

Figure 50: Manage Miscellaneous Services Screen

The entire current miscellaneous service list will be displayed.

To add new miscellaneous service user will click on the Add miscellaneous service

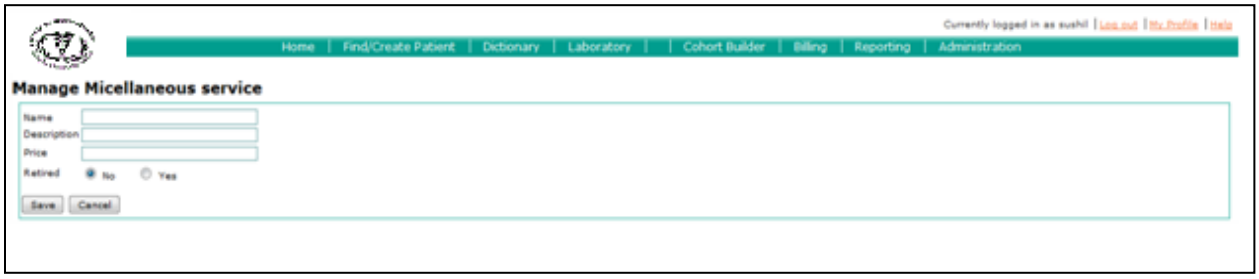

Figure 51: Add new Miscellaneous Service Form

Enter the details of service that you need to add as shown below

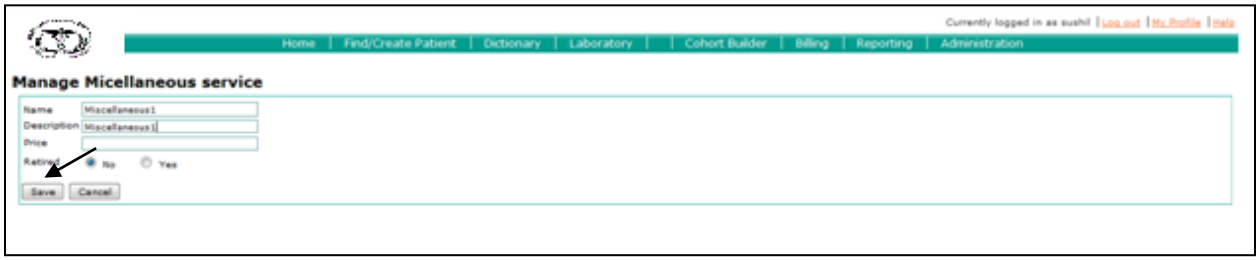

Figure 52: Save Miscellaneous Service

Then click on **Save tab.** The Service will appear on the window of Manage miscellaneous service after saving as shown in the window below

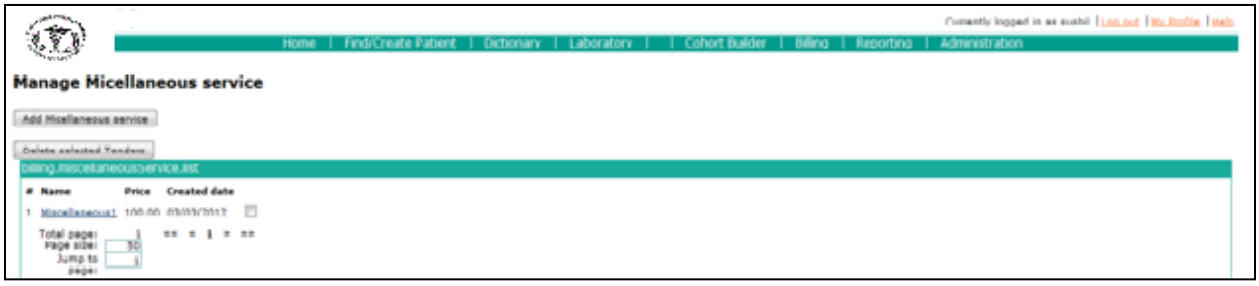

Figure 53: Miscellaneous Services List

To delete the service user have to click in the box which is after created date, and then user have to click on the delete selected Tenders tab

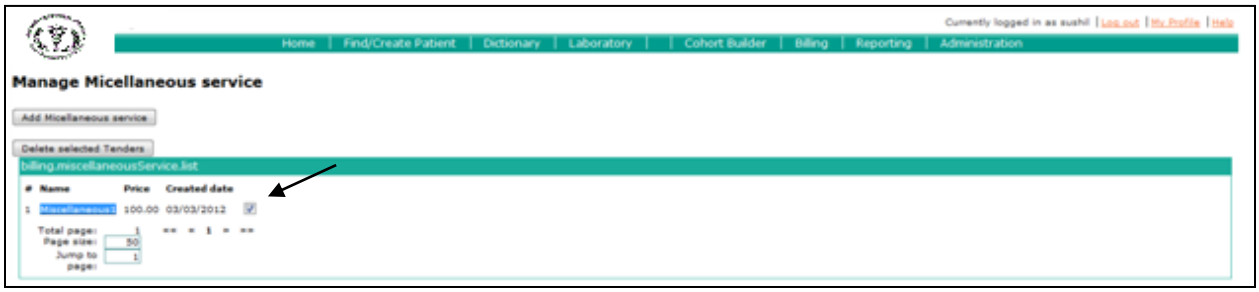

Figure 54: Delete Miscellaneous Service

After that service will disappear on the window of Manage miscellaneous service as shown in the window below and it will show the note on the top of the screen

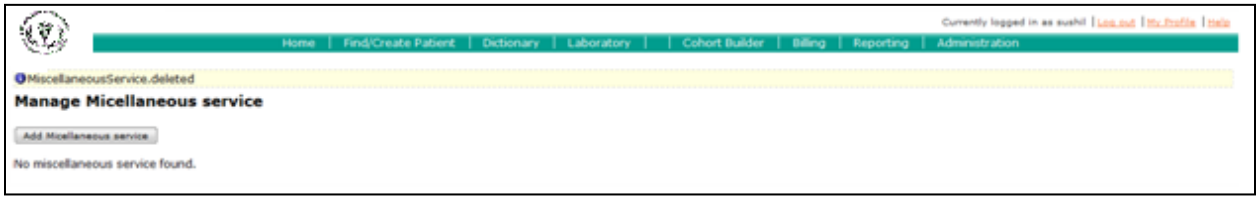

Figure 55: Miscellaneous Service List after deleting

- **Manage driver:**

This functionality helps to view and add drivers. Go to **Adminstration** option displayed on the main tool bar of the screen and click on the **Manage Driver** option listed under Billing

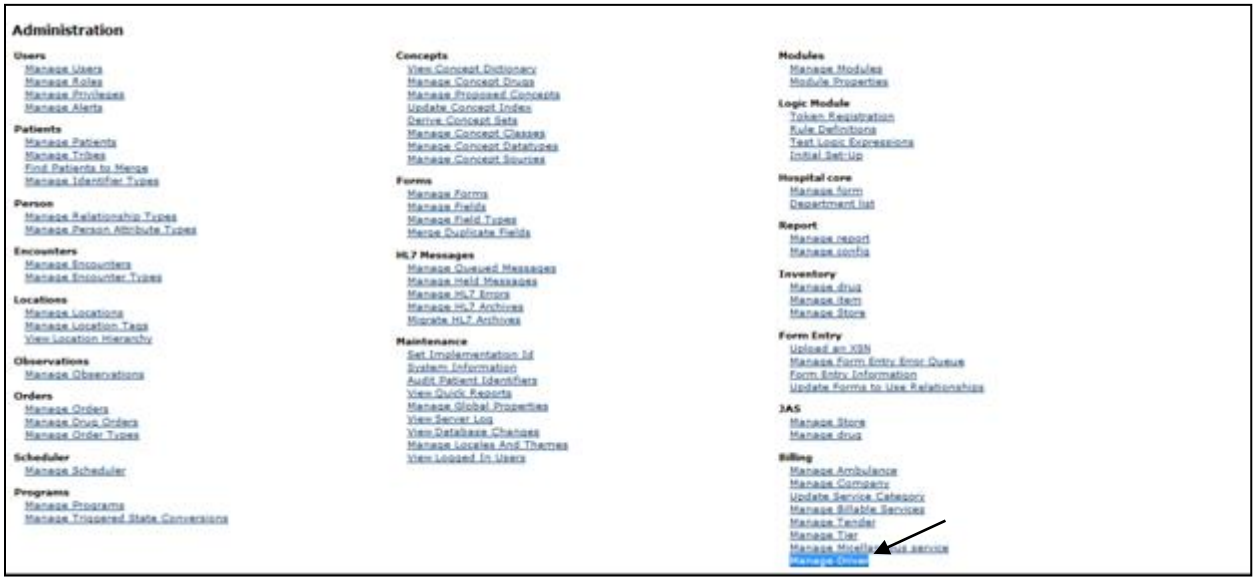

Figure 56: Administration Screen for Mange Driver

The following window will appear

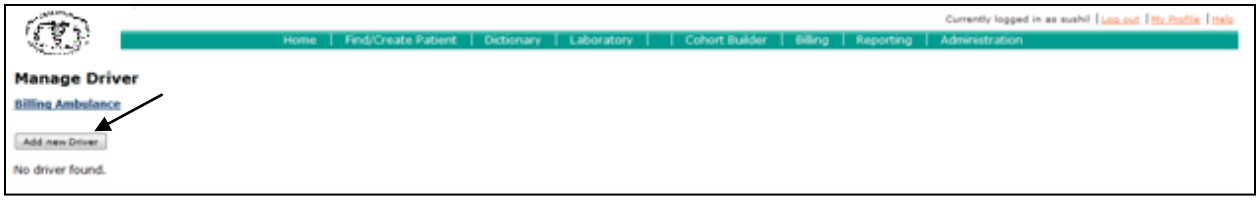

Figure 57: Manage Driver Screen

The current list of drivers will be displayed
To add new driver user have to click on add new driver tab
The following window will appear

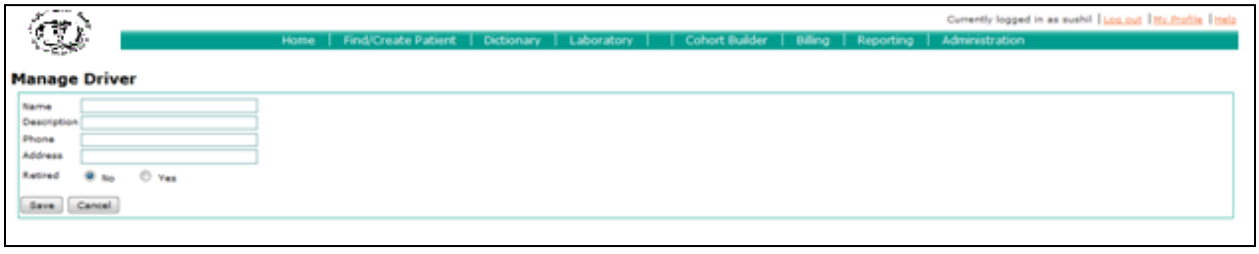

Figure 58: Add new driver form

Enter the details of service that you need to add as shown below

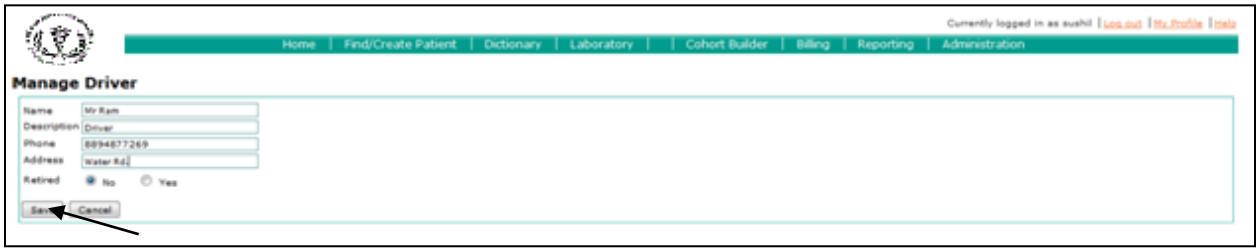

Figure 59: Save add new driver form after filling details

Then click on **Save tab.** The driver will appear on the window of Manage driver after saving as shown in the window below.

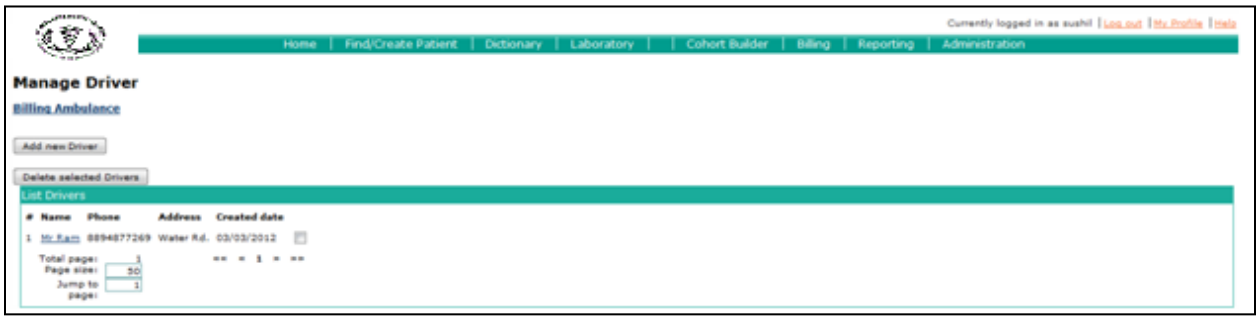

Figure 60: Driver List

By selecting the name of the driver user can edit the name and description of the driver and then user have to save it.

To delete the driver user have to click in the box which is after created date, and then user have to click on the delete selected drivers tab

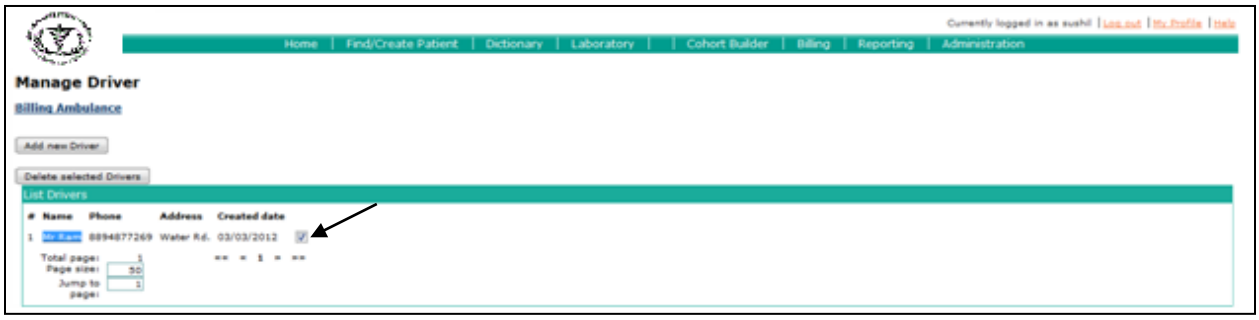

Figure 61: Delete driver

After that driver will disappear on the window of Manage driver as shown in the window below and it will show the note on the top of the screen

iii. Laboratory Module

This functionality helps to create, edit and delete Labs.

Go to **Adminstration** option displayed on the main tool bar of the screen and click on the **Manage department** option listed under **Laboratory**

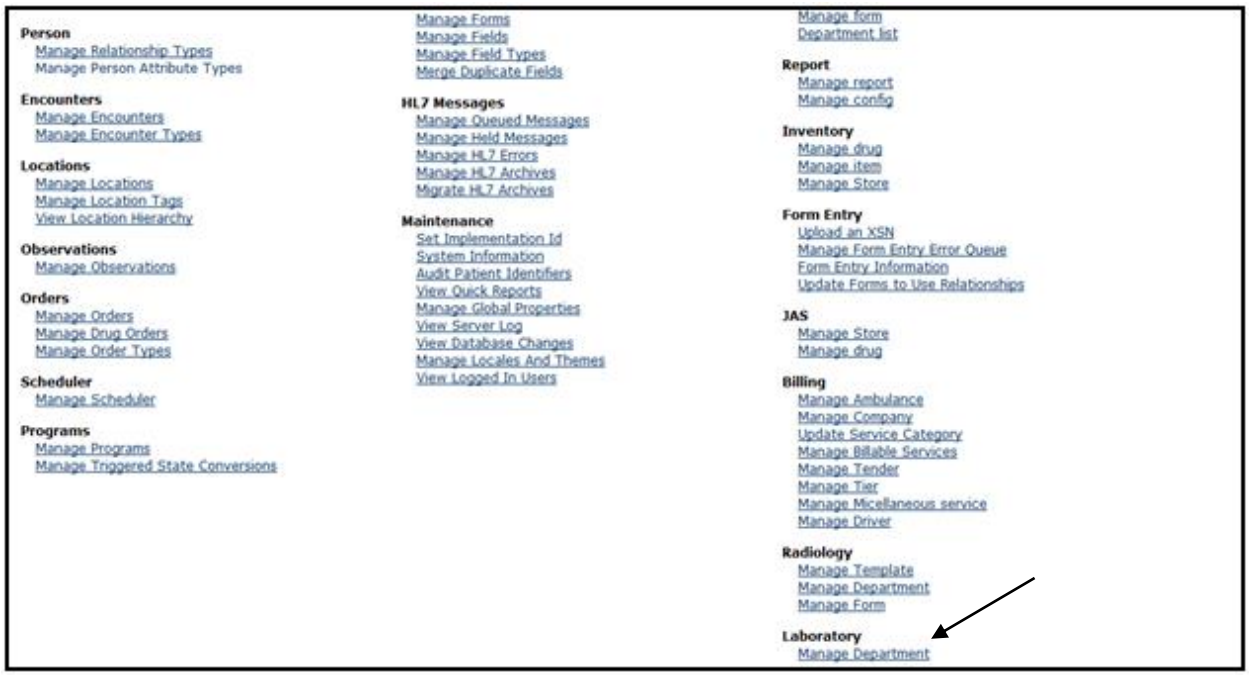

Figure 62: Administration Screen for Manage Laboratory

The following window will appear

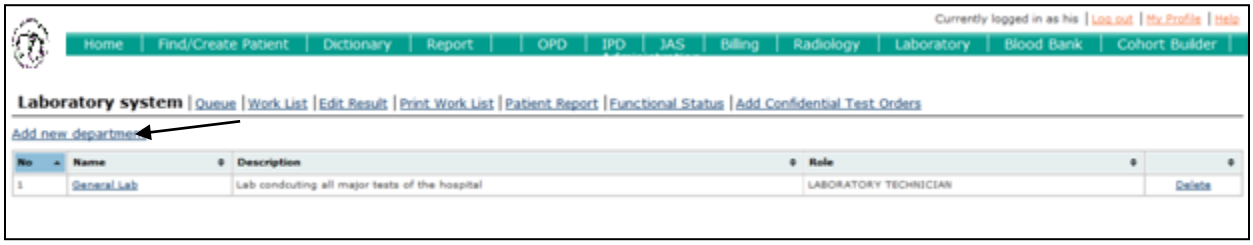

Figure 63:Manage department screen

List of existing labs with description will be displayed in the window. To add a new lab click on "**Add new Department**" tabs.

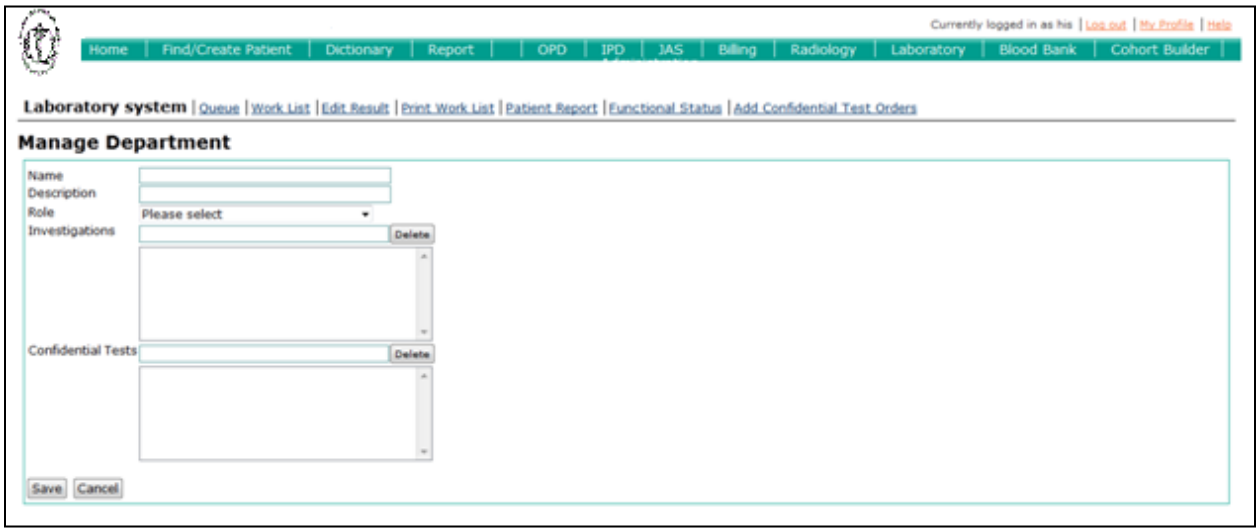

Figure 64: Add new department form

Enter the name, description, role (Lab Technician exclusively created for managing lab), Now add the investigations by pressing on the Add tab, find concept window appears as follows.

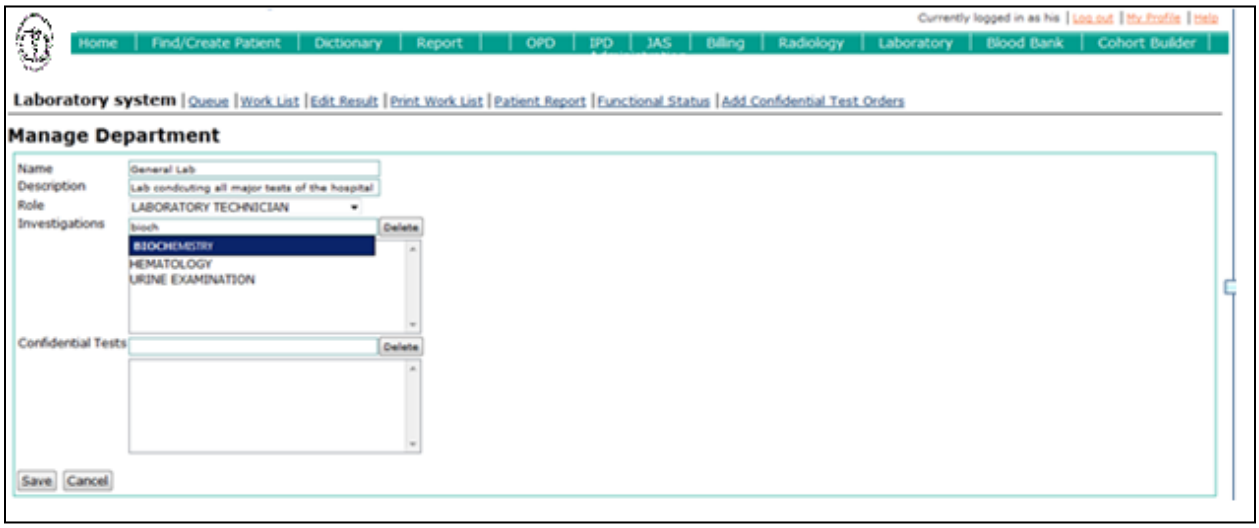

Figure 65: Add new department form with entering Lab name and selecting examinations

Here we enter the name of the lab that needs to be added. The General lab caters to 5 sub labs; they have been added as Serology, Hematology, Biochemistry, Urine Examination and Cytology as shown above.

In the same way confidential tests if any can also be added. Now fill in the "Reschedule period" and click on **Save** tab

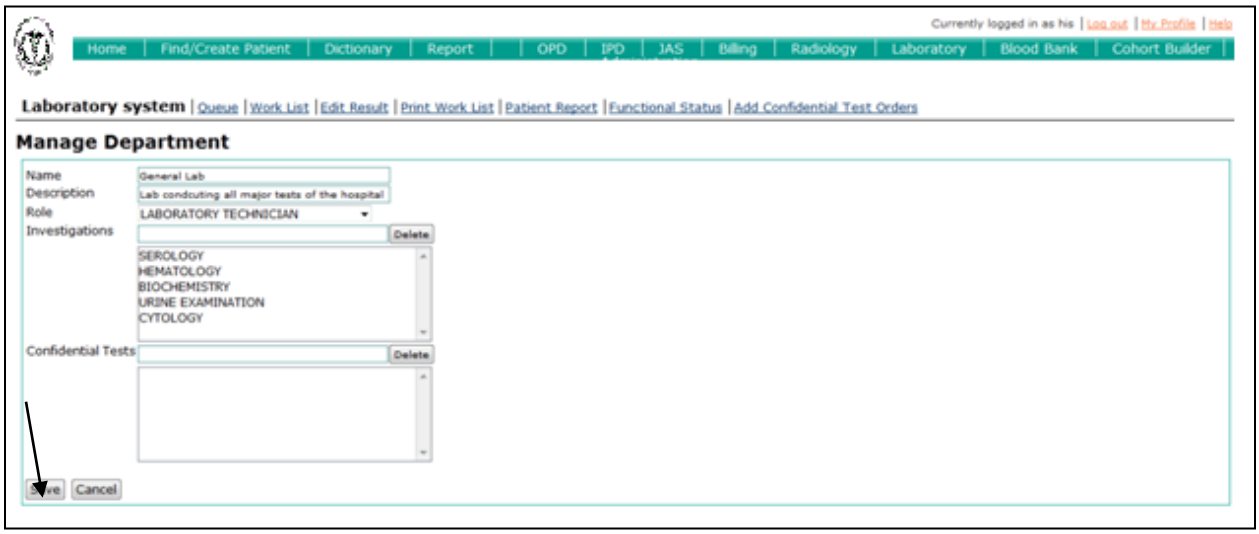

Figure 66:Save form

By selecting the name of the LAB user can edit the name and description of the Lab. To save the edited lab click on **"Save"** tabs. After saving the Lab, the following window appears

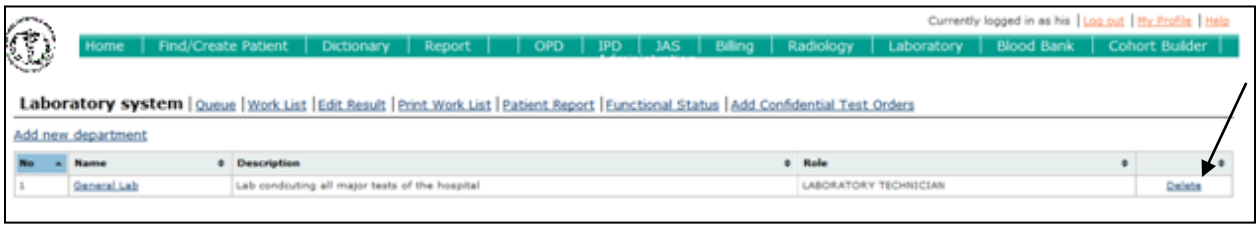

Figure 67:Departments list

To delete a Lab, mark the box in front of the Lab and click on "**Delete**".

iv. OPD & IPD Module

The customization of OPD and IPD module includes mapping of the department list so that they appear in their modules.

This functionality of Department list enables the OPD and IPD user to add the various departments in their module.

Go to Adminstration option displayed on the main tool bar of the screen and click on the **Department list** option listed under Hospital Core.

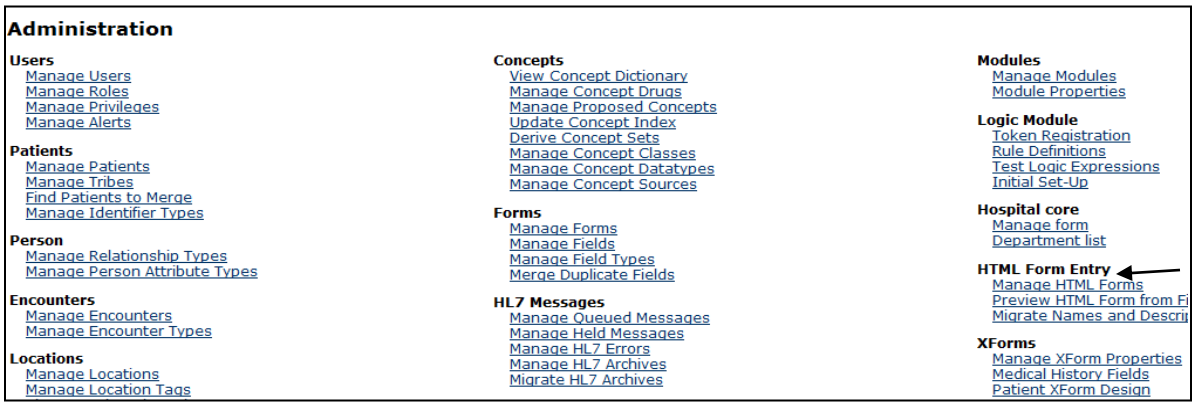

Figure 68: Administration Screen for OPD and IPD department

After clicking on the department list, **Manage department** screen appears with option of Add department. To add new department click on Add department

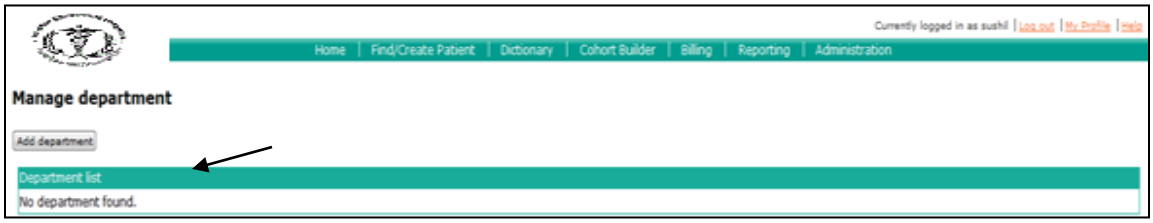

Figure 69: Manage Department Screen

Its important here to check the department that you want to create already exists in not. Check the list of departments that already exist. If the department that you want to create doesn't exist click on the add department tab and the following window appears

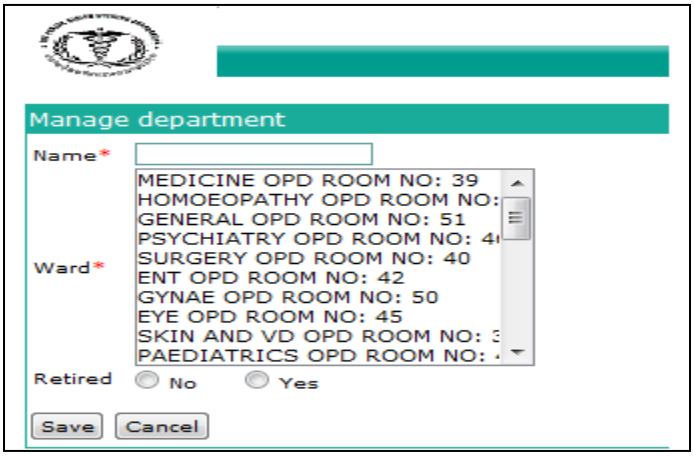

Figure 69: Add department screen

Enter the name of the department like Medicine OPD, and the select from list the particular OPD or IPD ward (this list is made while preparing the database) and the select retired or not (i.e. the particular concept exists or not in the database.)

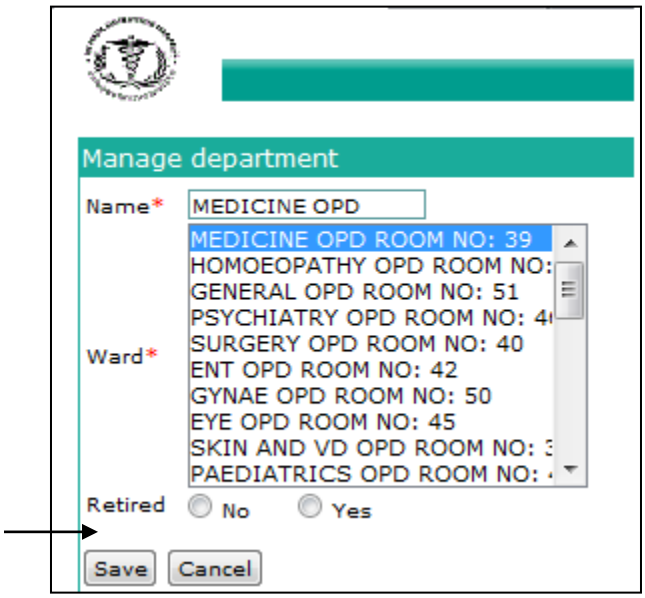

Figure 70: Save Department

Then Click on **Save tab .**The department that has been created will appear on the following screen.

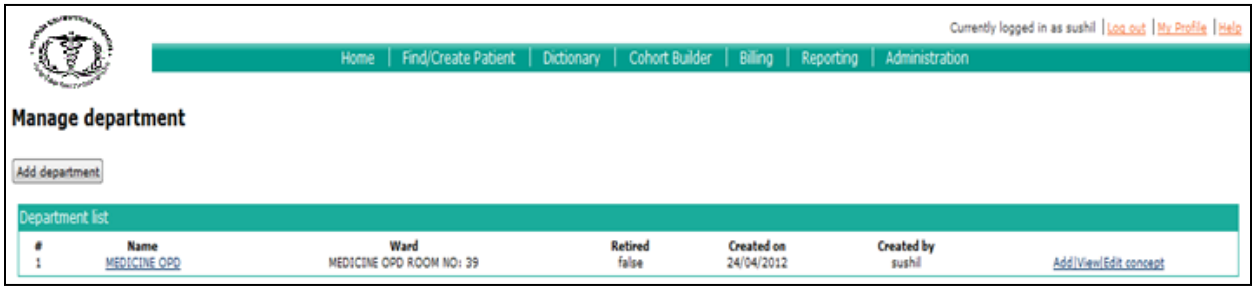

Figure 71 : OPD and IPD department List

v. Inventory Module

The customization of inventory module of HIS includes:

- Manage Store
- Manage Item

- Manage Drug

- **Manage Store**

This functionality enables the Inventory manager to create new Stores.

Go to Adminstration option displayed on the main tool bar of the screen and click on the **Manage Store** option listed under Inventory.

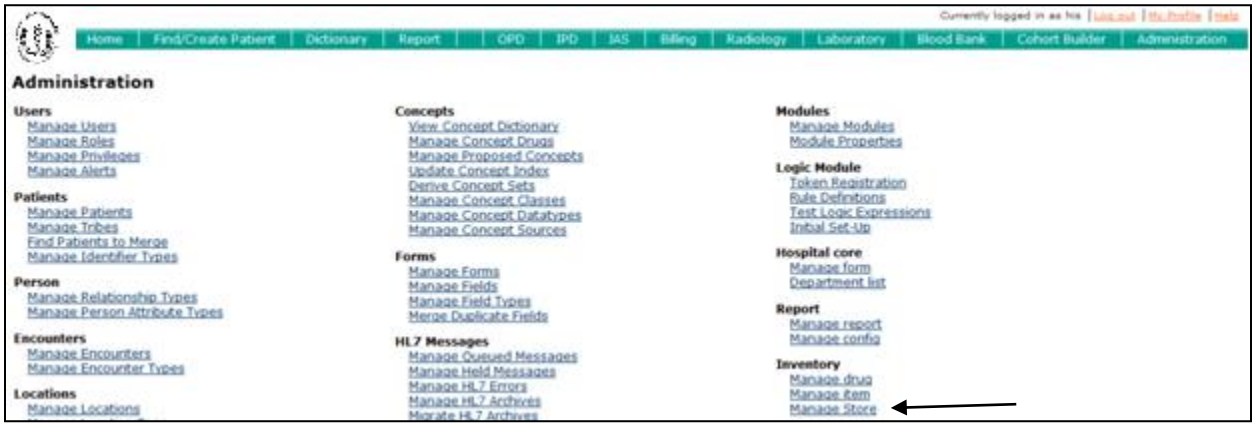

Figure72: Administration Screen for Manage Store

After clicking on the Manage Store, The Manage Store screen appears with list of operations like Add Store and Delete elected Store. To create a new store Click on **Add Store.**

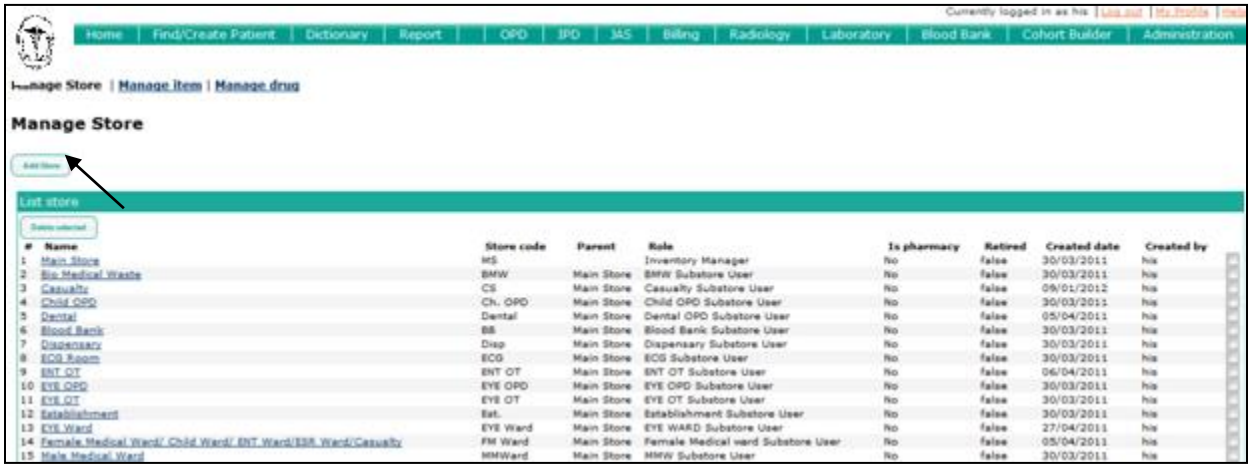

Figure 73: Manage store screen

Its important here to check the store that you want to create already exists in not... Check the list of stores that already exist. If the store that you want to create doesn't exist click on the add store tab and the following window appears.

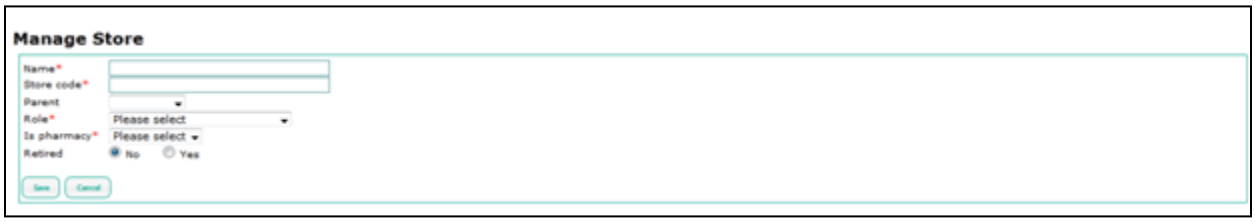

Figure 74: Add new store form

Enter the name of the store and then store code after that select the role of the store (e.g.: Inventory Manager , Pharmacy User, lab admin etc.) from the drop down that appears .After selecting the role , if the store is pharmacy then select yes else no.

Note: While creating Main store the Parent will be blank, for all other store that we create subsequently ensure to make Main store as the Parent. Only then Main store will serve as recipient of all indents and ensure transfers to respective sub stores.

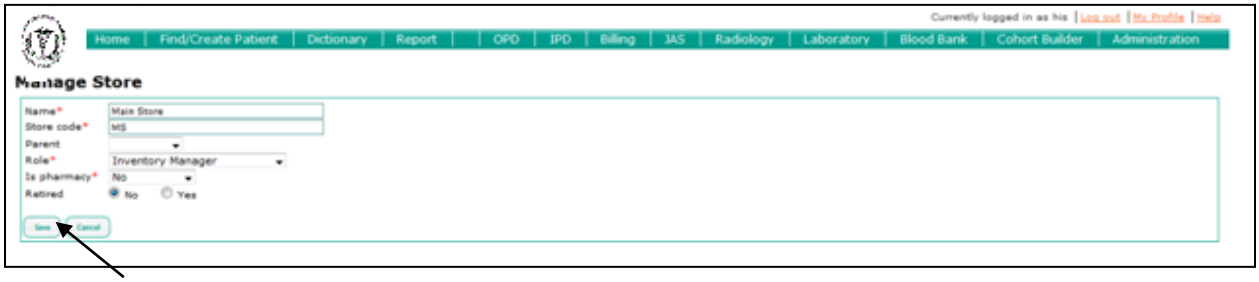

Figure 75: Save form

Then Click on **Save tab .**The store that has been created will appear on the following screen.

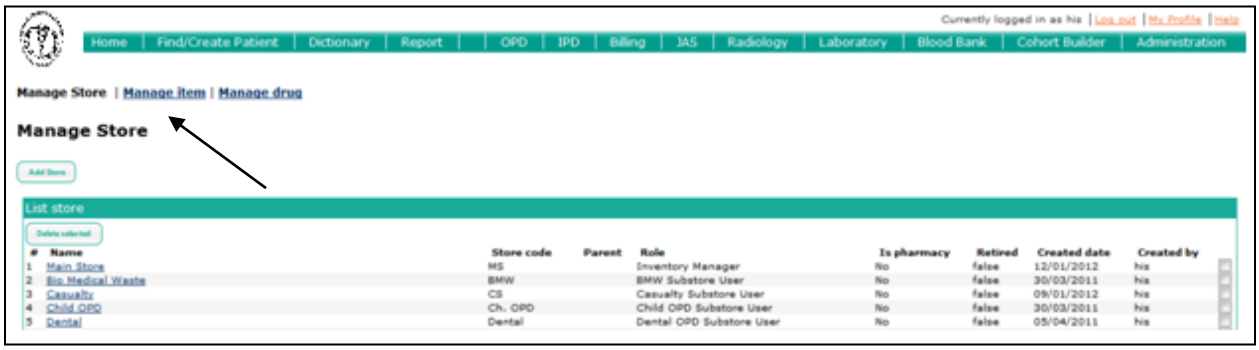

Figure 76: Store list

- **Manage Item**

This functionality enables the Inventory Manager to indeax a new item. To index an item you first need to create catergories, sub catergories , unit , specifications and then finally manage (index) an item.

Go to **Adminstration** option displayed on the main tool bar of the screen and click on the **Manage item** option listed under Inventory.

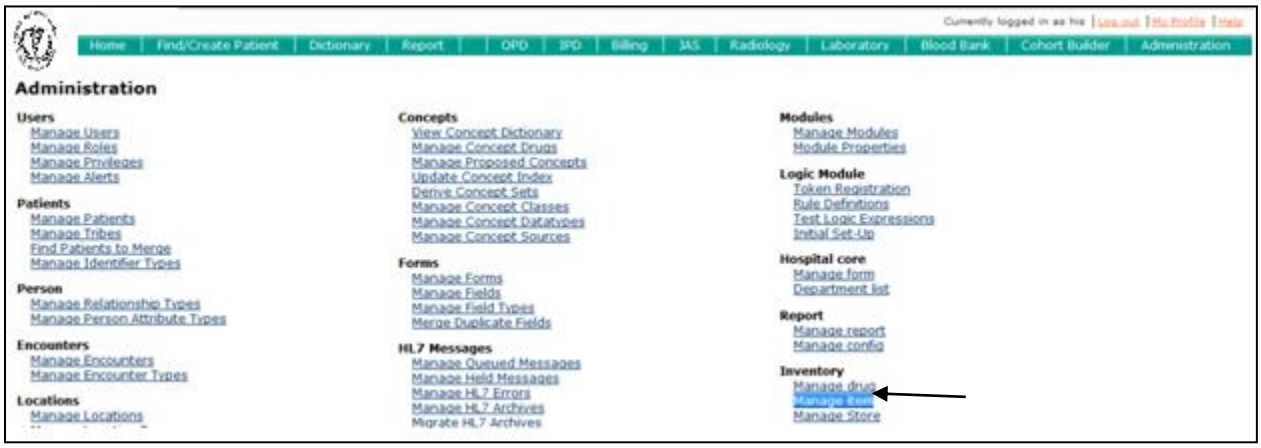

Figure 77: Administration Screen for Manage Item

By clicking on **Manage Item** the following screen appears with list of operations

- Manage Category
- Manage Unit
- Manage Subcategory
- Manage Specification
- Manage Item

Figure 78: Manage Item Screen

Manage Category

This functionality enables the Inventory Manager to create and view categories like dead stock, consumables. Etc. The name of the category, its description, and date of creation and created by are displayed.

A search function is also available to find the desired category. Type the name of the category (or first three alphabets of the name of the category) on the tab and press search; the system will search for the c category.

To add new category click on the **Add Category**

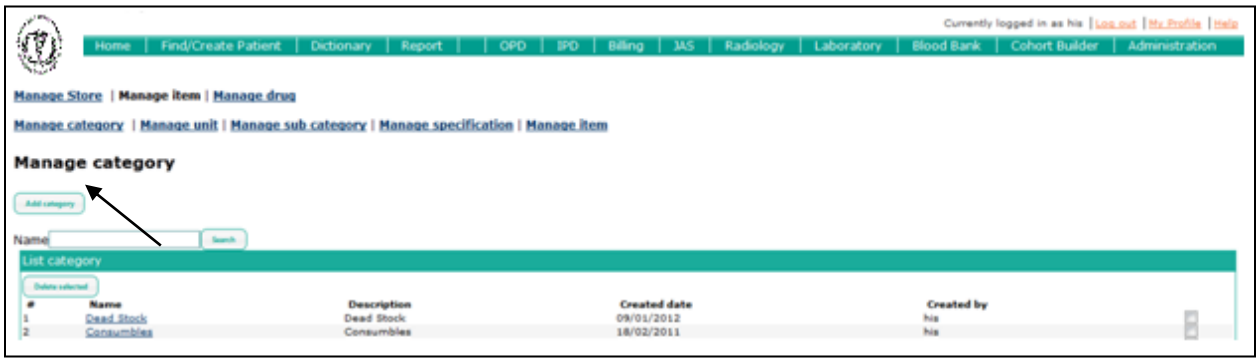

Figure 79:Manage Category Screen

The following window will appear:

Figure 80: Add new category

Enter the name and description of the category that you need to add as shown in the window below:

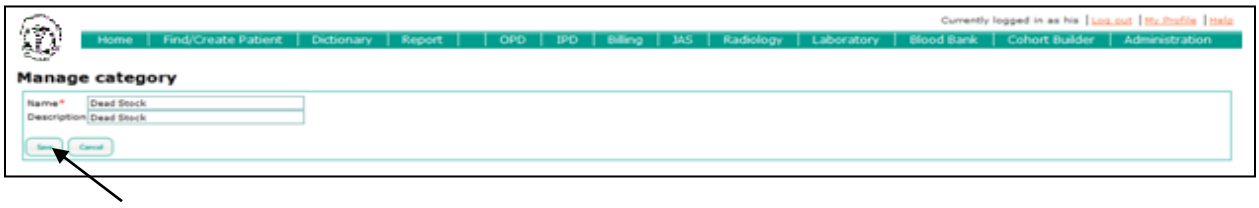

Figure 81: Save new category form

Then click on **Save tab.** The category will appear on the window of Manage Category after saving as shown in the window below:

Figure 88: Category list updated

Manage Subcategory

This functionality enables the user to create or View Sub-categories like Medical consumables, linen etc which includes the name of the category, Description, created date, created by.

To add new subcategories click on the **Manage Subcategory**

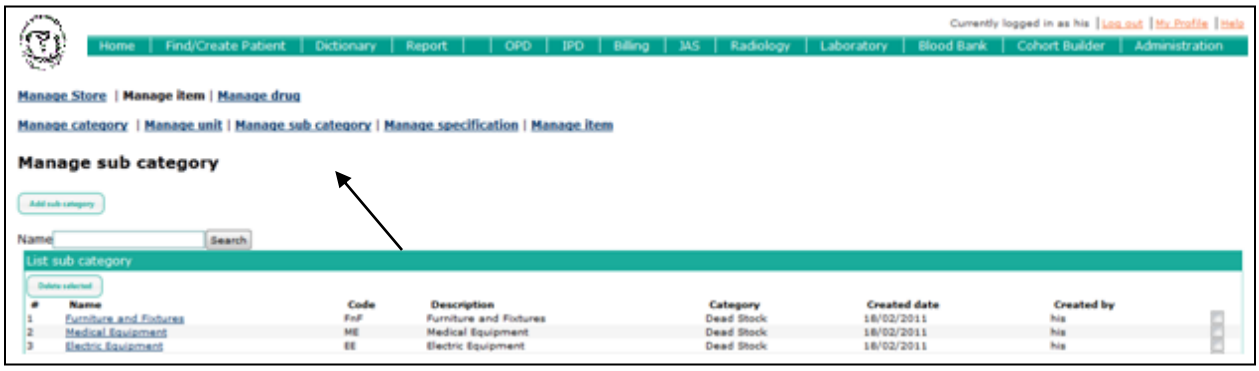

Figure 83:Manage subcategory selection

Then click on the **Add Sub Category** tab and the following window will appear

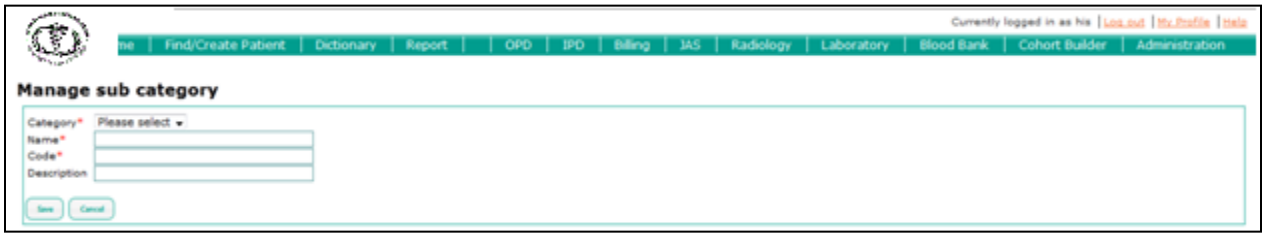

Figure 84: Manage sub-category form

Select the category from the drop down and then enter the name of the sub category (eg: linen falls under Consumables) after that give a code to that sub category.

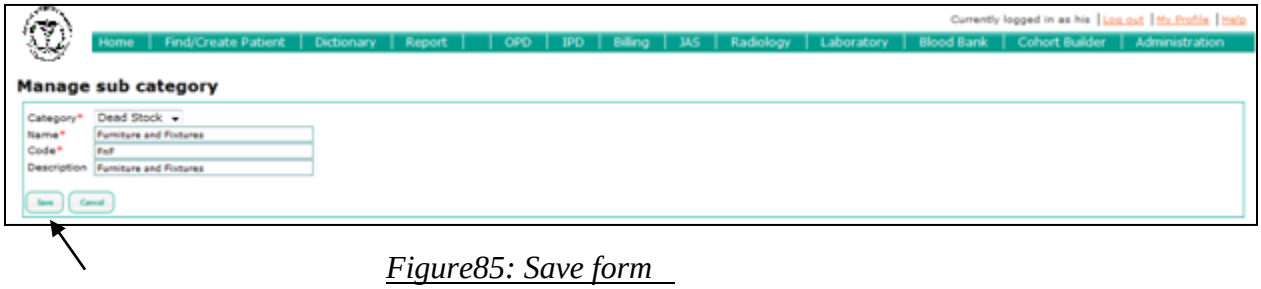

Figure85: Save form

Then click on the **Save tab**. The created sub-category can be viewed on the screen of Manage Subcategory. The window will be appearing like this after saving.

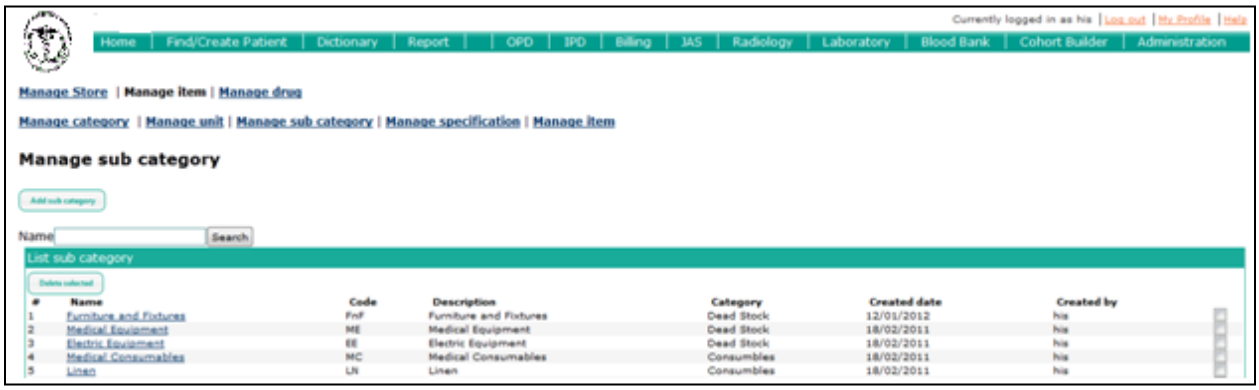

Figure 86: List of subcategory

The Inventory Manager does not want to add any sub category then press on the cancel Tab

Manage Unit

This functionality enables the Inventory Manager to create or View units like each, roll etc which includes the name of the unit. When you press on the, Description, created date, created by with Search Functionality

To add new unit click on the **Add Unit.**

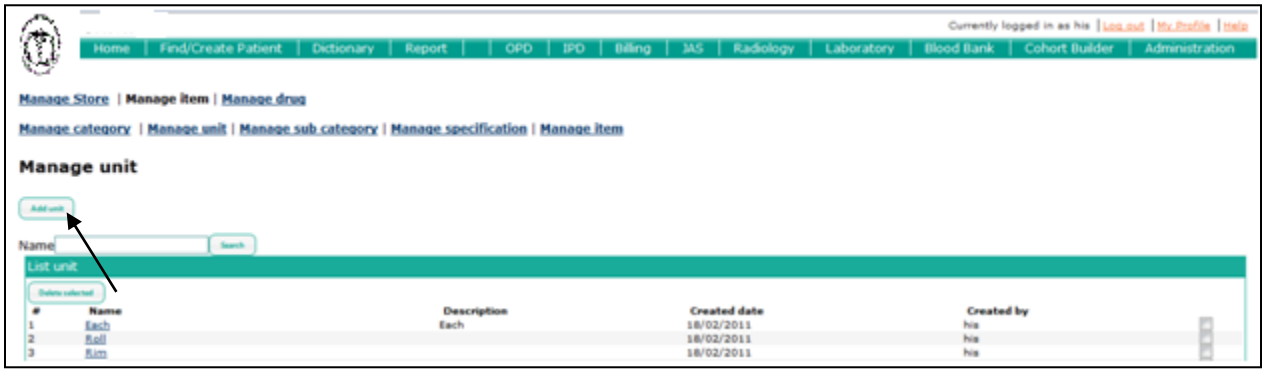

Figure 87: Add unit selection

Then click on the add unit following window will appear

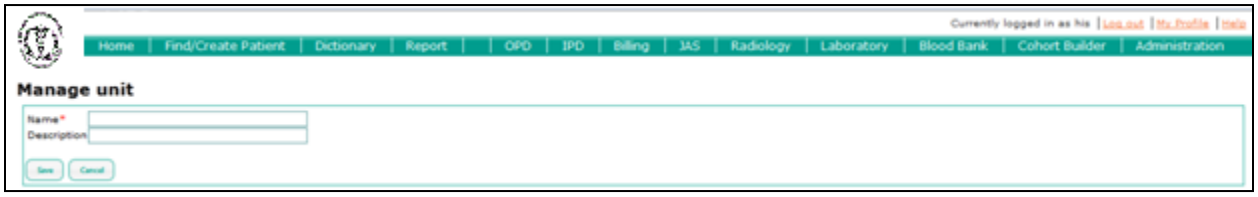

Figure 88: Add new unit form

Enter the name and description of the unit that needs to be added.

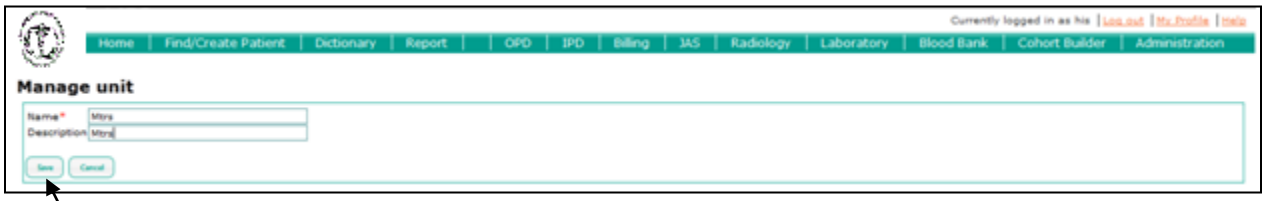

Figure 89: Save form

Then Click on **Save tab**. The unit which is added will appear in the following window after saving.

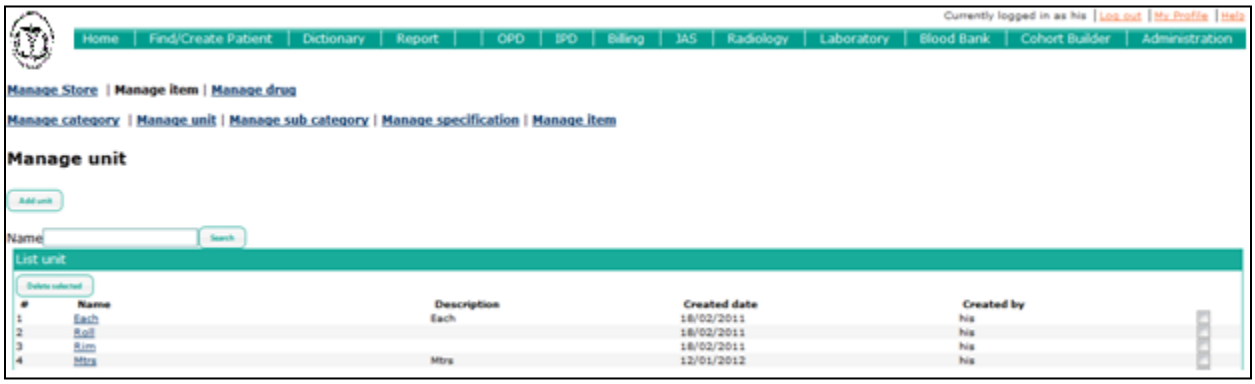

Figure 90: Unit list

Manage Specification

This functionality enables the Inventory manager to add specifications to the item. It is not a mandatory field. Certain items come in multiple specification in terms of colour (Red, blue, yellow, green) size (small medium large) volume (2ml 5ml 10 ml)

Select the **Manage Specification tab** from the menu

The following window will appear with list of operations like **add specification** and **Delete Selected**

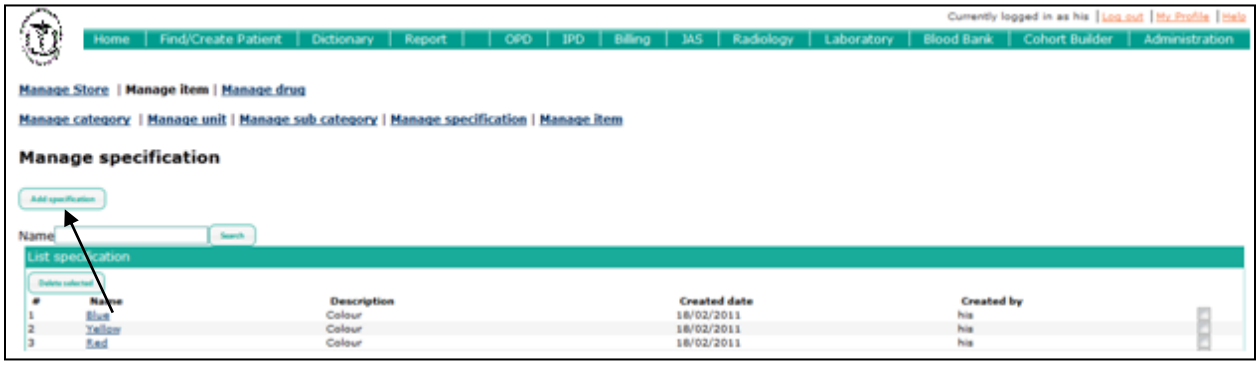

Figure 91: Add specification option

Then click on the **Add Specification** following window will appear

Figure 92: Add new specification form

Enter the name of the specification (e.g. black) and description (colour)

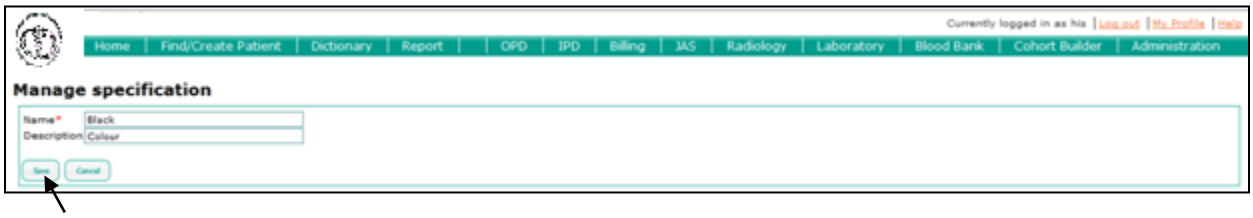

Figure 93: Save specification

Then Click on the Save tab . The specification that we just added (size) appears in the list as shown in the following window :

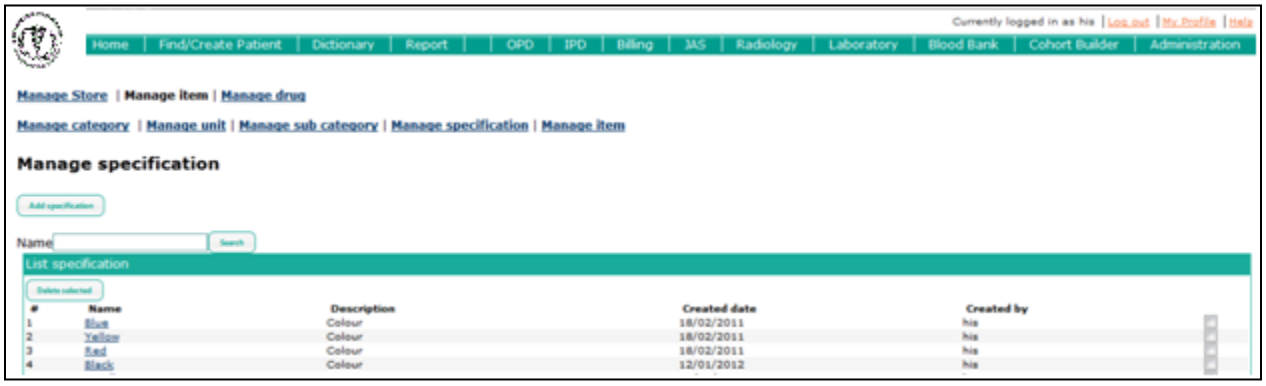

Figure 94: Updated specification list

Manage Item

The Functionality enables the inventory manager to add or view item in the stock. This also includes the name of the item, description, created date and created by with Search functionality

Click on the **Manage Item** on the menu.

The following window will appear with list operations like Add item, Delete selected

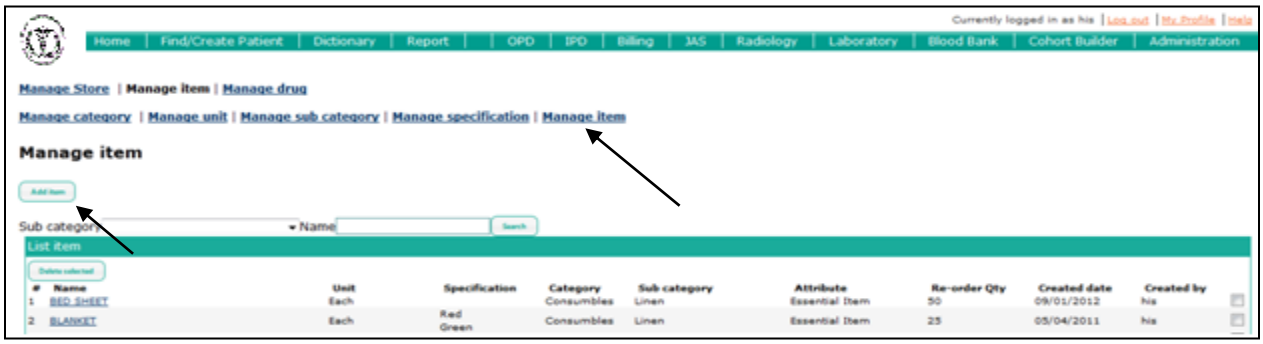

Figure 95: Manage item screen

By clicking on the **Add item tab** the following window will appear

Figure 96: Add item form

Enter the name of the item (e.g.: bed sheet) then select the unit from the drop down that appears and then specification of the item ,after that sub category of the item ,and then attribute whether the item is essential or non-essential, if it is essential enter the re order quantity as shown below

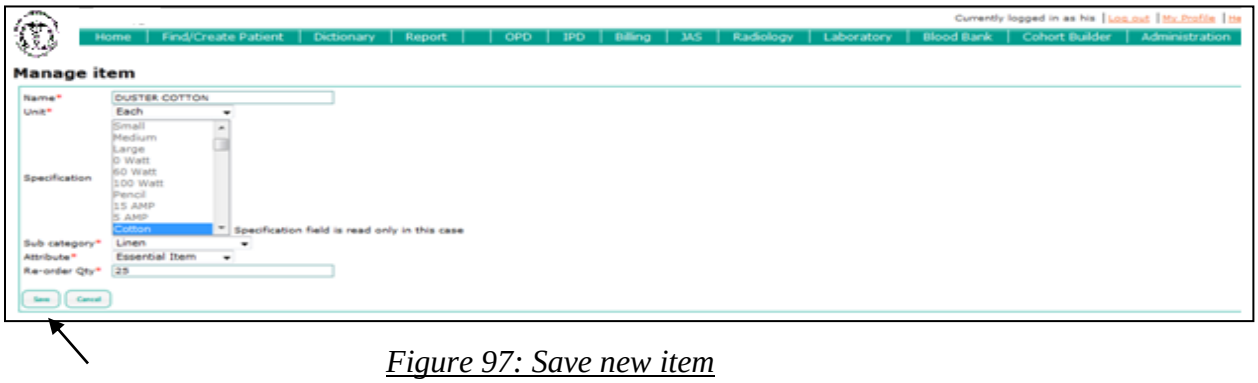

Figure 97: Save new item

Then Click on the Save tab, the item appears in list as shown in the on the following window

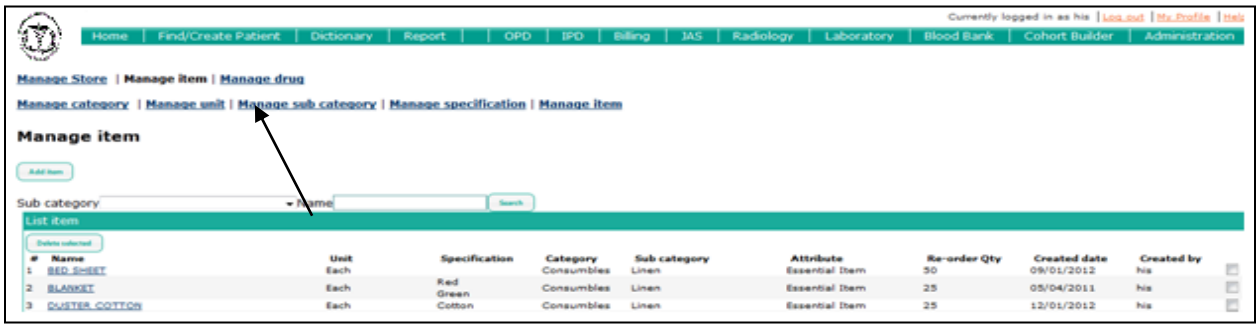

Figure 98: Updated item list

- **Manage Drugs**

The functionality enables the inventory manager to either add or view drugs with list of operations

- Manage Category
- Manage Unit
- Manage Formulation
- Manage Specification

Figure 99: Manage drugs screen

Select **Manage Drug** in the administration from the inventory or else select **Manage Drug from** the menu. The Following screen appears

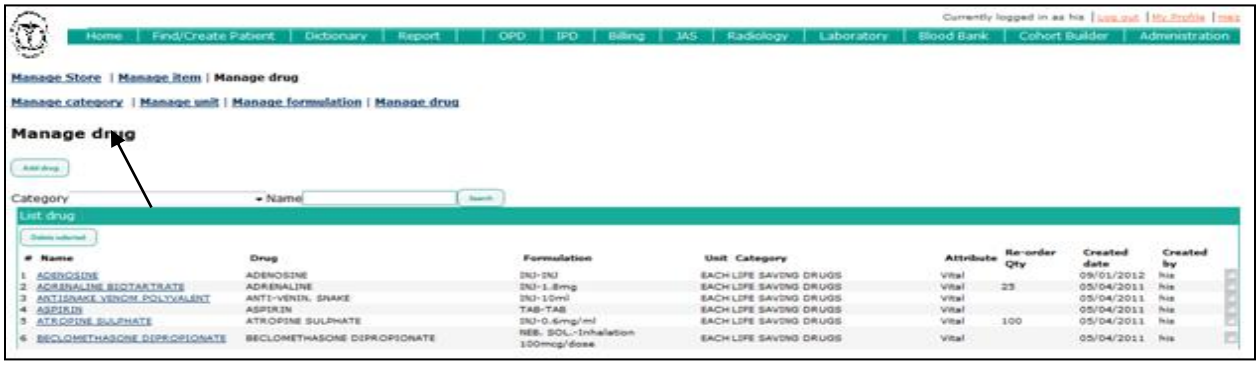

Figure 100: Manage drugs screen

Manage Category

The Functionality enables the inventory manager to create categories for different drugs which includes name of the drug, description created date, created by with Search Functionality

Click On **Manage Category** the following window appears with list of operations like ADD Category, Delete selected

Figure 101: Manage category screen

Click on the **Add Category**, the following window will appear

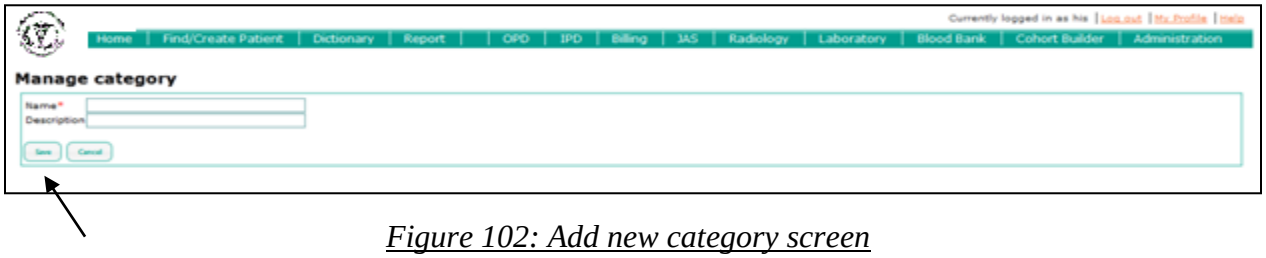

Figure 102: Add new category screen

Enter the name (E.g. Anti anemic drugs) and description of the category

Figure 103: Save new category

Then Click on the **Save** Option. The drug catergory appears in the following screen after saving.

Figure 104: Updated category screen

Manage Unit

The Functionality enables the Inventory manager to create units for drugs like pack, strip etc

To add the new unit of the drug select **Manage Unit** in the menu

The following window will appear

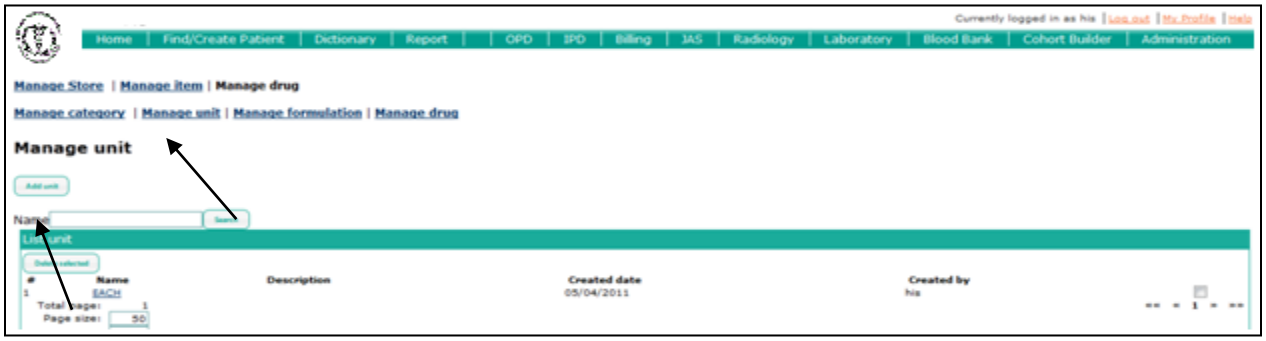

Figure 105:Manage Unit Screen

Click on the add unit following window will appear

Figure 106: Add new unit form

Enter the name of the unit (e.g. each, strip, pack) and then description of the unit

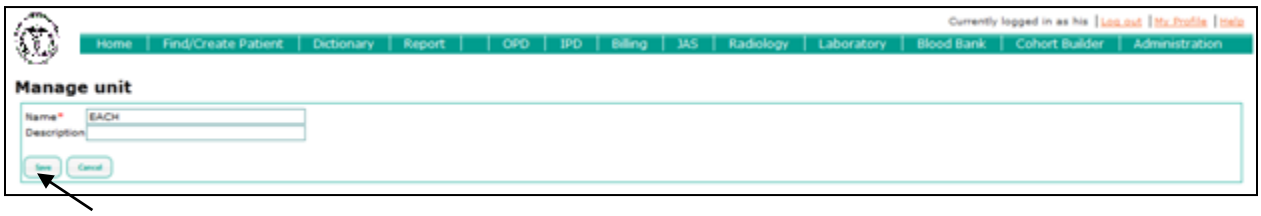

Figure 107: Save new unit

Click on **Save** the unit; you can see the unit in the following screen.

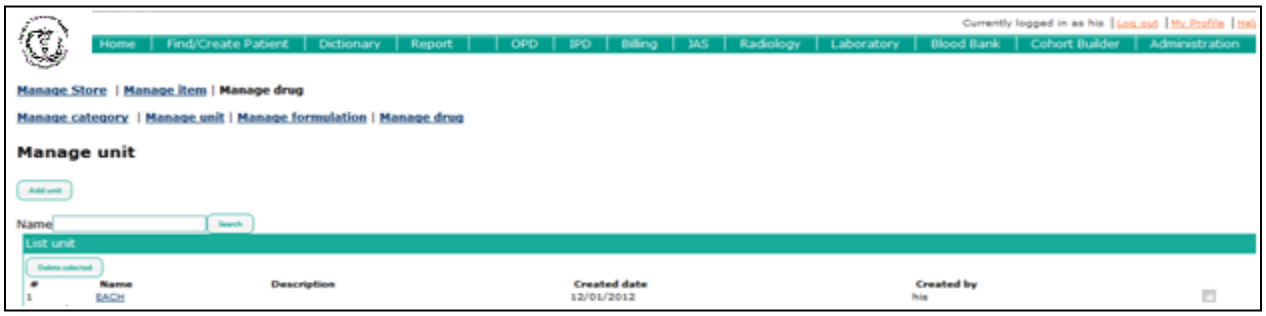

Figure 108: Updated Units list

Manage Formulation

The Functionality enables the inventory manager to create formulations to the drugs.

Go to manage formulation in the menu, if you will click on the **Mange Formulation** the following window will appear

Figure 109: Manage Formulation Screen

To add a new formulation click on the **Add Formulation Tab** before adding the new formulation Its important here to check the formulation that you need to create , if it already exists you need to check Check the list of formulations that already exist. If the drug that you have entered has a formulation that matches with a formulation already exit this window, else create new formulation by clicking on the **Add Formulation option**.

The following window will appear

Figure 110: New formulation form

Enter the formulation (ex: inj, tab) then enter the dosage (ex: 1mg, 1mg/ml) then description about the formulation

Figure 111: Save new formulation

Click on **Save** the formulation; we can see the added formulation in the list.

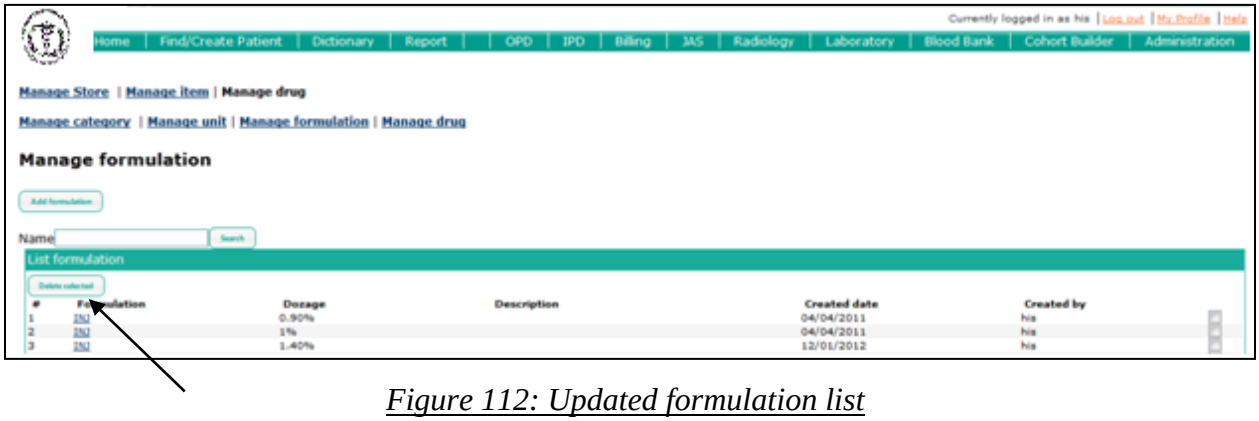

Figure 112: Updated formulation list

Delete Selected Option is used when the Inventory Manager do not want the formulation to be used in the list of the formulations .By Clicking on delete selected, the selected formulation can be deleted. The formulations which are already in use can't be deleted.

After Category, unit and formulation have been created we can index (manage) a drug.

- **Manage Drug**

To view existing drugs in the stock click on the **Manage Drug tab the** Following Screen appears:

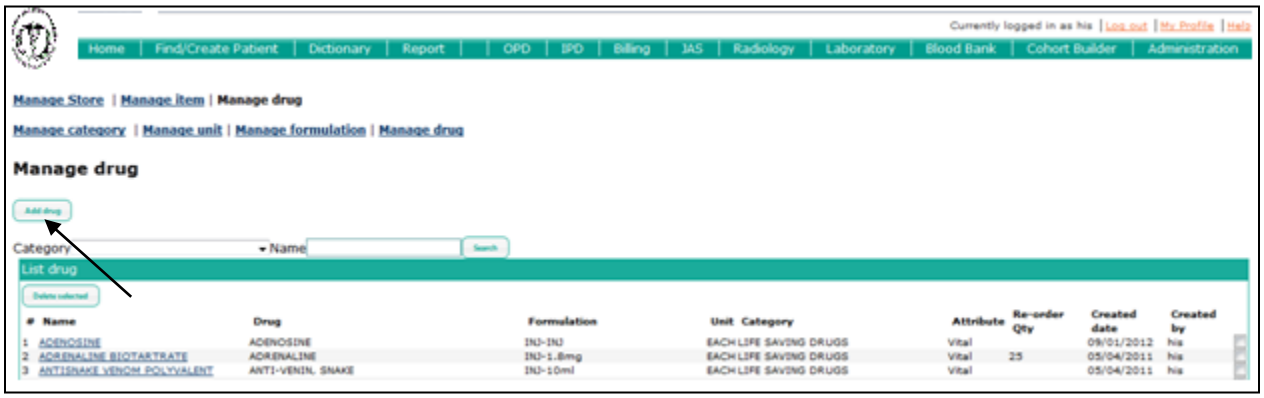

Figure 113: Manage drug Screen

Ensure from the list that appears that the drug you want to create isn't there; you can also use the search function to find the desired drug. If the name of the drug does not appear in the list press on the **Add Drug tab** and the following window will appear

Figure 114:Add new drug form

Enter the name of the drug (e.g. diazepam). Each Drug has been mapped in the System. Then map the name of the Drug with its concept, and then select the desired formulation from the drop down that appears. Next, select unit from the drop down that appears then drug category. All the drugs have an attribute, vital, essential desired, that select the requisite attribute for that drug, if the drug is essential drug enter the re-order qty.

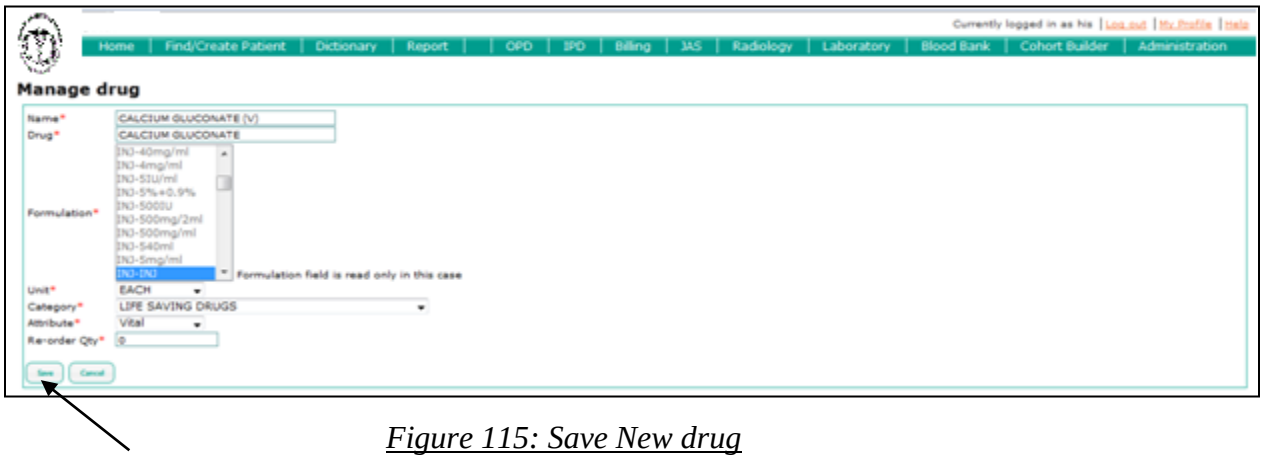

Figure 115: Save New drug

Then click on **Save** Option. The drug will appear in the following screen.

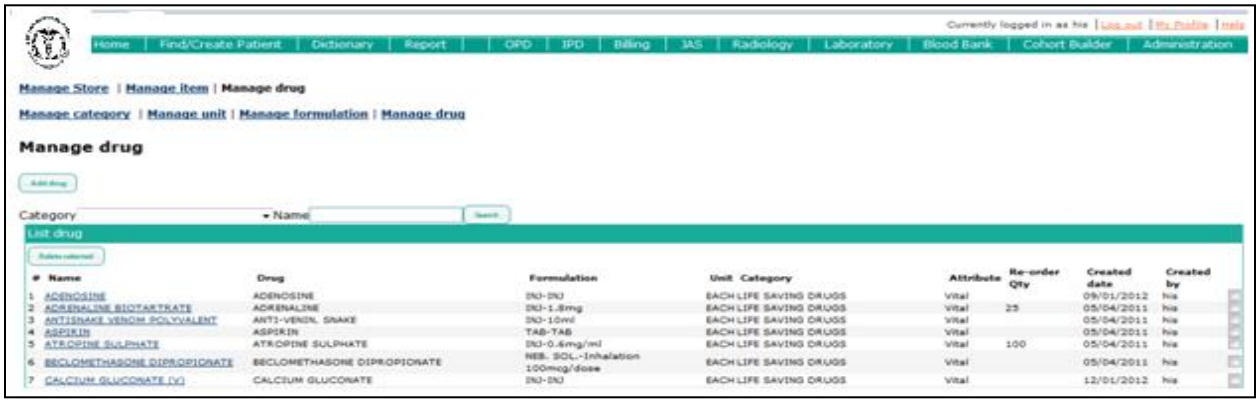

Figure 116: Updated drug list

Delete Selected Option: this functionality enables the user to delete an item which is not in use.

Note: *An item can only be deleted if it's not being used in any transaction else it is not possible to delete an item*

B.3 Check list before testing the application(Annexure 2)

There is a checklist for the customization before the testing begins. It is important to check all the customization has been done or not before the testing of the software begins. Thereby a checklist is made for the same. (Annexure 2)

C. Developing Testing Protocols :

Testing is an important step which is to be done after the customization of the software is complete. Once the modules were developed in accordance with the hospital requirement, each of it was put on rigorous testing by the developers. The modules were run offline and checked for every possible error. The practice was continued for a period of 15 days to ensure the smooth working of every module.

The testing of Modules is done in 2 rounds

Round1:

In this round the whole process flow of the system is tested by logging in as an System administrator and it is also seen that the modules are functioning or not in a proper flow.

Round 2:

In this round the process flows of different module is checked by logging in as specific role. E.g. Laboratory Module is tested by logging in as Lab Technician and Lab Administrator. By this way it can also be tested that the roles and privileges which are assigned are working or not.

The following is the testing life-cycle which includes the following steps:

C.1 Test Planning

Activities at this stage would include preparation of high level test plan-(according to IEEE test plan template). The Software Test Plan (STP) is designed to prescribe the scope, approach, resources, and schedule of all testing activities. The test plan identifies; testing items, features, type of testing, resource, schedule, risks, testing condition (manual/ automated, etc.). Almost all of the activities done during this stage are included in this software test plan. This planning will be an ongoing process and it is reviewed frequently.

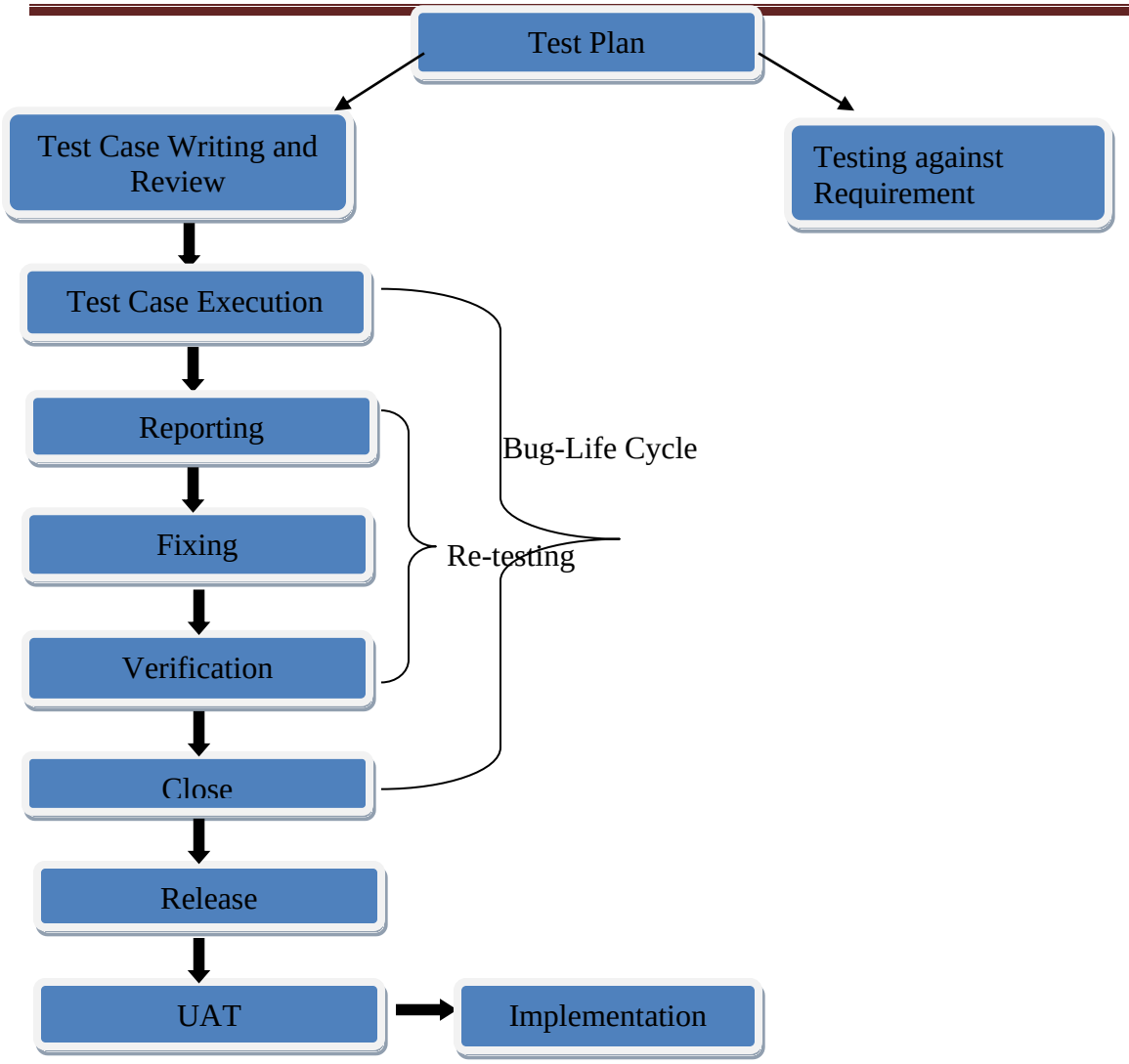

Figure 117: Testing Life-Cycle

C.2 Test Analysis and Designing Test Cases

Regular meetings were held between testing teams, project managers, and development teams, to check the progress in the development which will give a fair idea of the development of the project and ensure the completeness of the test plan created in the planning phase, which will further help in enhancing the right testing strategy created earlier. Subsequent to this, the functional validation based on SRS was developed to ensure that all system requirements are covered by one or more test cases identify which test cases we also have to define areas for Stress and Performance testing. The Test case format is shown below in **Figure.** Once the

environment setup is complete, the independent modules tested to check the broad functionalities.

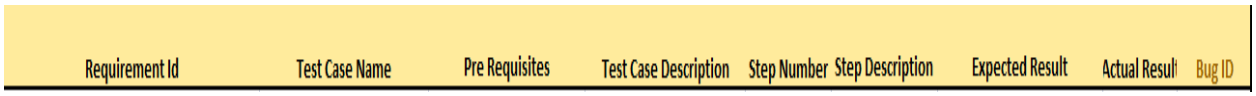

Figure 118: Test Case Format

C.3 Execution & Verification

In this phase all the manual test cases are completed, scripting of the automated test cases, stress and performance test cases needs to be completed. Review of Test Cases & their defect incorporation is also done in this phase only. Integration tests with other modules are performed and errors (if any) are reported. An example is shown below in Figure.

RUN 2: TO VERIFY THE SEARCH FOR A PATIENT DETAIL FUNCTIONALITY IN APPLICATION

Requirement Id	Test Case Name	Pre Requisites	Test Case Description	tep Numb	Step Description	Expected Result	Actual Result	Bug ID
		Data Seeded for User Name and Password and URL for the application and Patient record must be exist in the system. User must be logged in to the systems with registration clerk user role.	To verify the search for a patient details Functionality for the application.					
				Step 1	Enter the Web Application by typing the URL in Mozilla Firefox.	The browser is redirected to the Login page		
				Step 2	Enter the correct user name and password for the application and click on the Login button	The Mozilla Firefox is redirected to the Application home page and the page is displayed with the following welcome message "Hello <User>. Welcome to DDU"		
				Step 3	Select the 'Find/Create Patient' option from the Home Page	The Patient Registration page is displayed.		
				Step 4	Enter the patient name (minimum initial 3 characters) in the name field.	Automatically, 1)If there are patients with the name: All the relevant patients names are displayed. 2) If there is no patient with the name: User registers the new patient in the system. And the page is rerouted to the selected patients information page.		
						Apart from Name patient can be searched by entering 5 parameters: 1) Gender 2) Age 3) Last Visit 4) Relative Name		

Figure 119: Test Case Example

After test case was executed, the result status is noted as shown in Fig

RUN 2: TO VERIFY THE SEARCH FOR A PATIENT DETAIL FUNCTIONALITY IN APPLICATION								
Requirement Id	**Test Case Name**	**Pre Requisites**	**Test Case Description**	**tep Numb**	**Step Description**	**Expected Result**	**Actual Result**	**Bug ID**
		Data Seeded for User Name and Password and URL for the application and Patient record must be exist in the system. User must be logged in to the systems with registration clerk user role.	To verify the search for a patient details Functionality for the application.					
				Step 1	Enter the Web Application by typing the URL in Mozilla Firefox.	The browser is redirected to the Login page	Pass	
				Step 2	Enter the correct user name and password for the application and click on the Login button	The Mozilla Firefox is redirected to the Application home page and the page is displayed with the following welcome message "Hello <User>. Welcome to DDU"	Pass	
				Step 3	Select the 'Find/Create Patient' option from the Home Page	The Patient Registration page is displayed.	Pass	
				Step 4	Enter the patient name (minimum initial 3 characters) in the name field.	Automatically, 1)If there are patients with the name: All the relevant patients names are displayed. 2) If there is no patient with the name: User registers the new patient in the system. And the page is rerouted to the selected patients information page.	Fail	Bug #129
						Apart from Name patient can be searched by entering 5 parameters: 1) Gender 2) Age 3) Last Visit 4) Relative Name 5) Phone No.		

Figure 120 : Executed Test Case

C.4 Re-Testing

In this phase the Test Cases Run ⟶ Report Bugs ⟶ Review test cases (if needed) ⟶ Add new test cases (if needed) ⟶ bug fixing ⟶ Retesting (test cycle 2, test cycle 3….).

C.5 Bug Life Cycle

Fail condition is logged and this initiates the process of defect tracking lifecycle. This is a system for receiving and filing bugs reported against a software project. The bug reporting is done on Redmine which is a Project management web application used for bug filing and defect tracking.

C.6 Final Testing and Release

Executed remaining stress and performance test cases, documentation for testing was completed/ updated, also check the User Feedback points that were given at Demo session in the client side that are incorporated or not. If not incorporated, than a new bug is logged and status is tracked till closure.

C.7 Testing Against Requirements

The testing of software also includes testing the modules against the requirements of the hospital. For e.g. In Mohali the requirement of Rs. 50/- against the admission file, it is necessary that during the testing the tester check that this is being captured in the HIS during the admission process flow.

Chapter 4:
RESULTS & FINDINGS

4.1 Pre-implementation Evaluation

Pre-implementation evaluation of the hospital process is necessary which helps in understanding the various workflows a well as the time taken at each step of the process.

For this the study was conducted among 2 categories of respondents- Staff and Patients. Staff helped in understanding the processes as well as the waiting time. And the patients helped in knowing the waiting time at different levels of the process.

Following graph tells us about the waiting time at different processes.

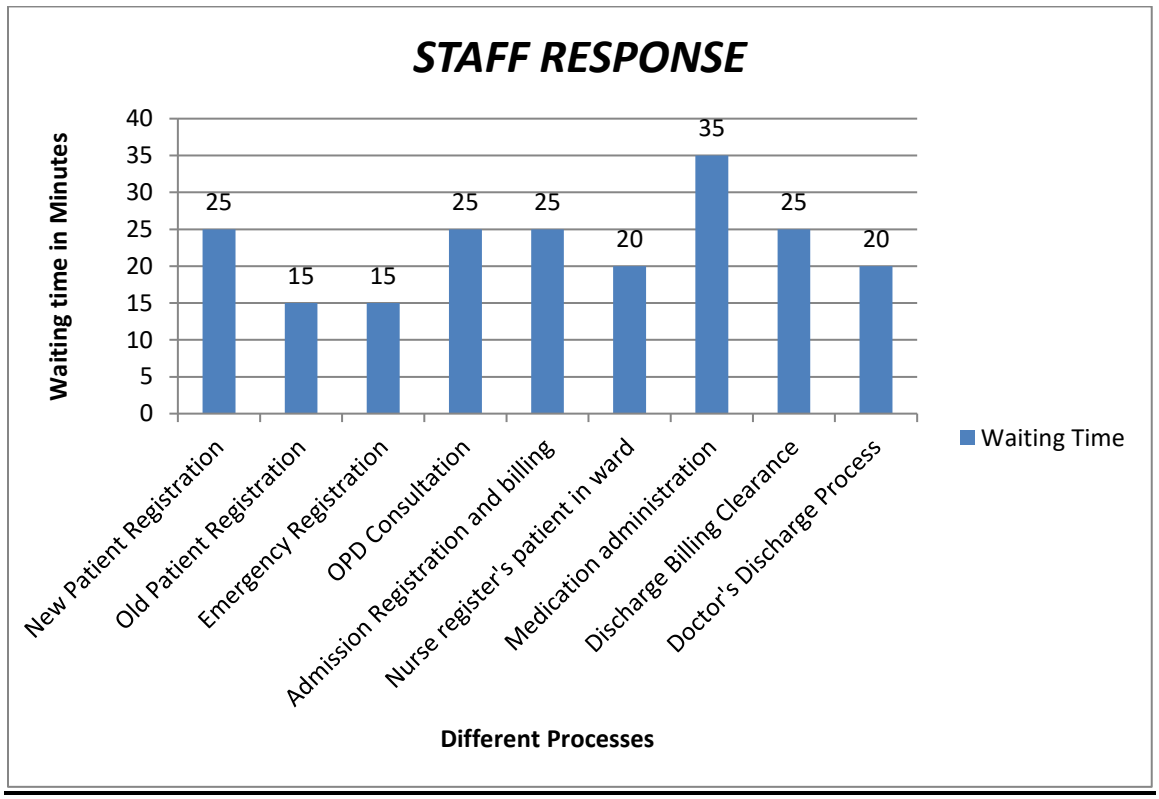

Figure 8: Staff's Response- Waiting Time vs. Different Processes

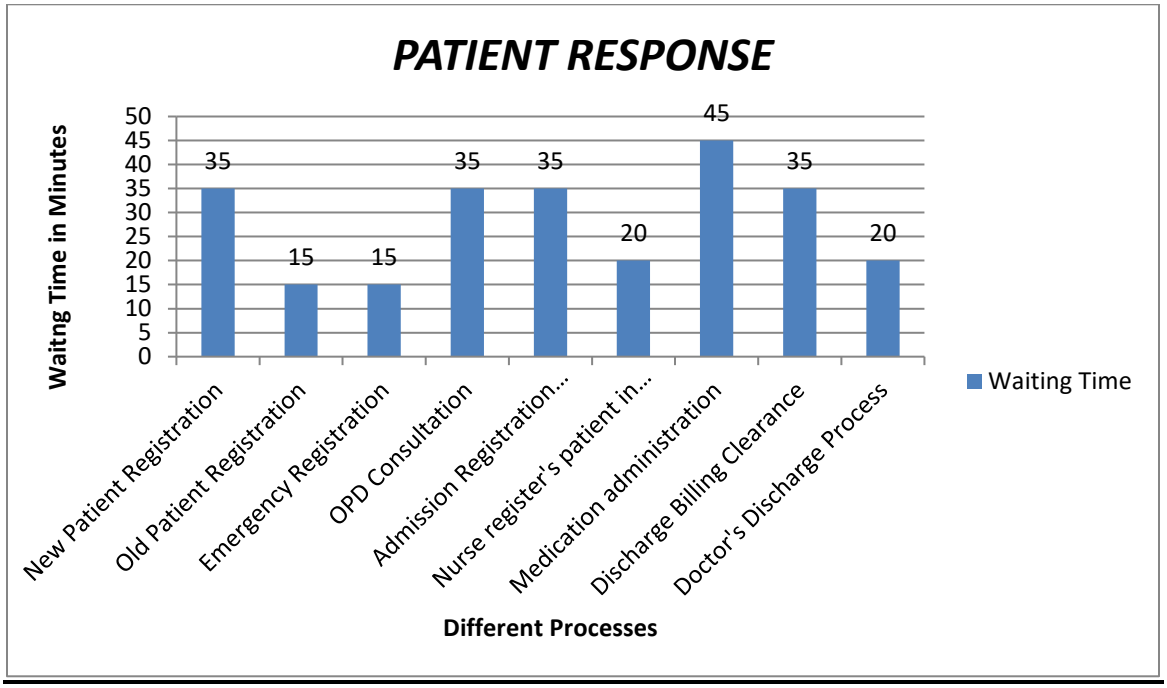

Figure 9: Patient's Response- Waiting Time vs. Different Processes

The diagram below tells us about the average waiting time at the different steps.

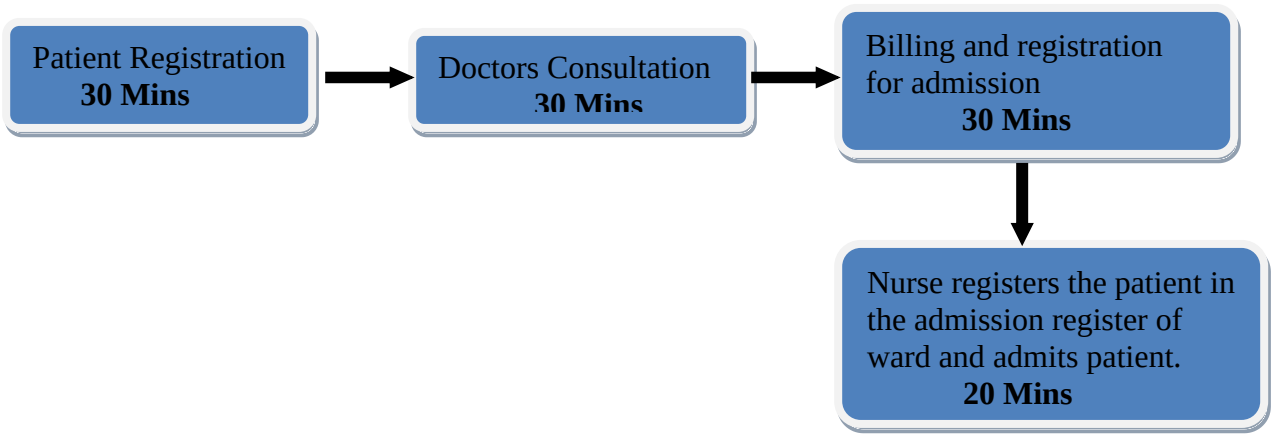

Figure 10: Process: OP to IP of a patient with waiting time

Thus the total waiting time for the OPD to IPD process flow is 110 minutes. This is a matter of concern for the hospital.

4.2 Outcomes of Customization & Testing:

Phase	Activities	Outcome
Planning	Create high level test plan	Test plan, Refined Specification
Analysis	Create detailed test plan, Functional Validation Matrix, test cases	Revised Test Plan, Functional validation matrix, test cases
Design	test cases are revised; select which test cases to automate	revised test cases, test data sets, sets, risk assessment sheet
Construction	scripting of test cases to automate,	test procedures/Scripts, Drivers, test results, Bugreports.
Testing cycles	complete testing cycles	Test results, Bug Reports
Final testing	execute remaining stress and performance tests, complete documentation	Test results and different metrics on test efforts
Post implementation	Evaluate testing processes	Plan for improvement of testing process

Figure 121: Test Activity Outcome

Chapter 5

Discussion and Observations

This study includes pre-implementation evaluation, customization of HIS and development of testing protocols for Civil Hospital, Mohali. For customization of software it is necessary to understand the various processes as well as have a good requirement study prior to it. The pre-implementation stud helped in understanding the processes. It was also evaluated during the pre-implementation study that the waiting time of a patient is about 200 minute, thereby it would be essential for the hospital to implement a HIS which would help in reducing the waiting time by streamlining the processes. Few of the observation during the study are as follows:

- It takes around 12-15 days for customization of the HIS by implementers. As the developers release the modules phase wise

- A checklist before the testing is necessary which helps in checking whether all the aspects of the customization have been covered or not.

- If any step in customization of any module will be missed pout the module would not function and also it will not allow the other modules to work completely as the modules functionality are linked to each other.

- It was observed during that if the requirements are not gathered properly then there would be problems during the customization process. Customization on the lines of requirements gathered from the hospital.

- Testing of any software is started after the customization of the HIS is complete. In the testing the gaps in the customization can be found out and the changes in the baseline can be made before the system is deployed in the hospital.

- One of the observations during Customization and testing was that the client or end –user's keeps on changing the requirements and adding new requirements, there by leading to re-customization and re-testing process.

-Various bugs and issues were found during the testing phases which were reported on the RedMine.

Chapter 6

Conclusion

This study has attempted to show, based on certain parameters, the waiting time of a tertiary hospital in Mohali. From the study we came to know that the total waiting time a patient experiences during the process of OP to IP flow is about 110 minute. This is a lengthy waiting time which could also delay the treatment process. Thus it is necessary for the hospital to take some action to reduce the waiting time and streamline the various processes in an organized manner.

Issues and challenges during the testing phase:

	ISSUE	EXPLANATION	STATUS
TESTING AGAINST TEST SCRIPTS	Accepting Future Date In Age	In the age it was accepting future age and viewing the age as null	Filed Bug
	Patient Category not Exclusive	The patient categories were not mutually exclusive. 2 or 3 categories could be selected simultaneously.	Filed Bug
	RSBY and BPL Validation	The validation of RSBY i.e. should not accept more than 6 patients with same RSBY number and BPL i.e. Should not accept more than 10 patients with same BPL number was not working.	Resolved
	Print on Temporary category selection	The print out of OPD slip was not coming on selecting temporary category.	Filed Bug
	X-ray and Blood Bank Forms not Viewed	X-ray and Blood Bank Forms not viewed on clicking on them because of the global properties where the form id number has to be the same as on	Resolved

		the form.	
TESTING FOR CUSTOMIZATION	Non-existence of concepts in database	Because some of the concepts did not exist in dictionary, the radiology investigation were not going from the queue of radiology	Resolved
	NAN in price in billing	Instead of rate/ cost of the investigation or services NAN occurs because the prices are not entered in the billing hierarchy.	Resolved
	Wrong Privileges given	Each role has privilege along with it, it was found that according to the role wrong privileges were assigned	Resolved
	Dropdown of select investigation not occurring.	The drop down for select investigation does not occur because the departments for it are not made in the module.	Resolved
TESTING FOR REQUIRMENTS	Patient Category	All the free patient categories do not exist in the system.	Resolved
	Billing prices not complete	All prices not there	Resolved

Chapter 7

Recommendations & Limitations

8.1 *Limitations of the study*

1. Software design limitation- Unmodifiable data fields (hard coded), absence of source code, lack of ownership of source code. [3]
2. The test cases were not updated as per the requirements of the hospital.
3. End-users always keep on changing the requirements.
4. They never agreed for a remote access to the server so changes in the customization with changing requirements had to be done at the end-users site
5. Follow up for filling the gaps of requirement due to patient load.
6. Communication with the developers was difficult as, developers were in Vietnam, so resolving the bugs was taking time.
7. All the decisions were taken by the state there was no involvement of the hospital.

8.2 *Recommendations*

1. Test scripts should be updated regularly

2. Re-processing of the requirement template should be done on regular bases so that the requirements are complete.

3. Sign-off should be taken from the users at the end of every step of requirement gathering process as the requirements don't keep on changing.

4. Implementation of HIS in hospital is not merely computerization and automation of the existing paper trail but a practice to improve the efficiency and effectivity of the hospital. This fact should be well delivered and conceived by the users.

5. Setting up of a local centralized IT department within the hospital to take care of HIS working.

6. Responsibility comes with accountability and hence the client side should be held equally accountable for any kind of changes and additions that has to be made to software.

Chapter 8

CASE STUDY ON USER PERSPECTIVE OF HOSPITAL MANAGEMENT INFORMATION SYSTEM

8.1 INTRODUCTION

Information Technologies (IT) have been described as offering tremendous opportunity to improve health services as well as in meeting broader developmental goals which have an impact on health. Through the use of IT, healthcare sectors can potentially plan, monitor and evaluate health services as well as communicate more effectively within and across organizational hierarchies.(3)

Decisions in the changing, competitive and highly complex health care market must be arrived at faster. The argument for the extensive use of computers by modern health care executives and the inclusion of computer training in the health administration curriculum rests on the fact that the survival and growth of health care institutions is vitally tied to the capacity of their managers to absorb increasingly complex data and turn it rapidly into usable information.

The overall goal of this system is to optimize the performance of health services at all levels of administration through the timely provision of necessary and sufficient information needed by the health managers to monitor, evaluate and plan their activities.(5,6) Its success requires a system that is integrated, decentralized, functional and reliable. (4, 6)

Acceptance is defined by Dillon & Morris (1996) [12]as the willingness within a user group to employ information technology to the tasks it is designed to support. There are two determinant factors of acceptance study: Perceived Usefulness and Perceived Ease of Use (Davis et. al., 1989)[13].

It is the doctors who are going to use the HMIS system, to improve the healthcare facility .Thus, it is necessary to understand the user perspective about HMIS. This case study aims at understanding the user Knowledge, attitude and behavior about IT application in their clinical practice.

8.2 OBJECTIVE

The study aims at analyzing the knowledge, attitude and behavior of Doctors and other healthcare professionals for use of HMIS in clinical practice.

8.3 METHODOLOGY

The study was conducted among doctors from 21st April '2012 to 27th April'2012. The method used for data collection is convenience sampling which included 25 respondents and the tool used for data collection is questionnaire (Annexure 1).

The data was analyzed using Bi- variate Correlation method in SPSS 16.0

8.4 DATA ANALYSIS & INTERPRETATION

- Firstly, Cross tabulation method was to interpret the user attitude of different users with the different age categories of the respondents.

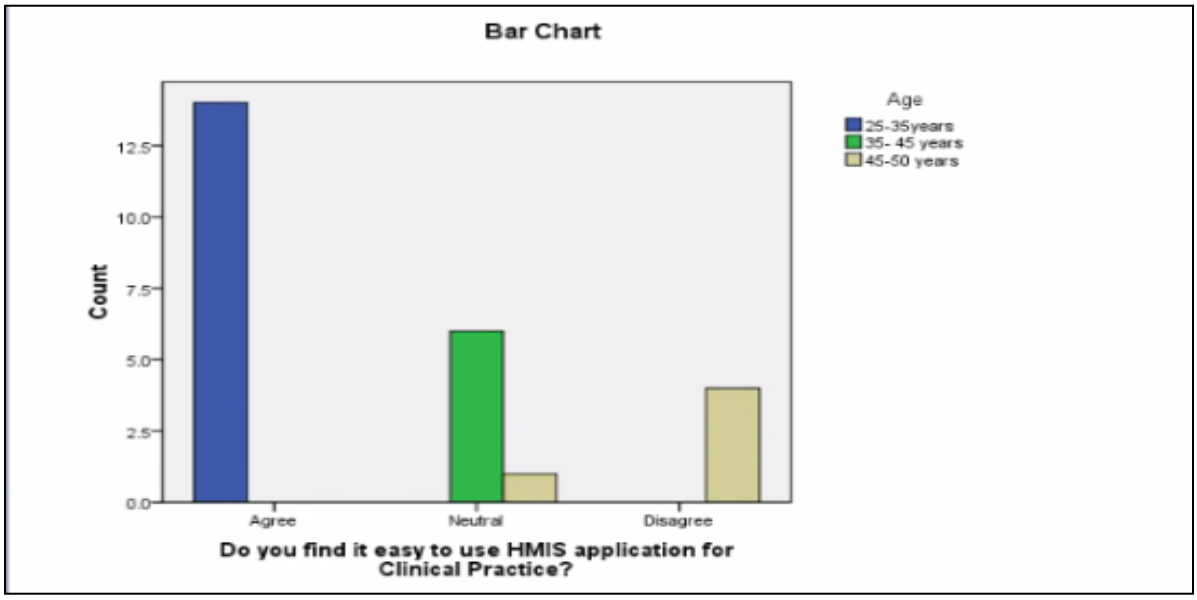

Figure 122: Age vs. Ease to use HMIS application for Clinical Practice

Do you find it easy to use HMIS application for Clinical Practice? * Age Crosstabulation

			Age			
			25-35years	35- 45 years	45-50 years	Total
Do you find it easy to use HMIS application for Clinical Practice?	Agree	Count	14	0	0	14
		% of Total	56.0%	.0%	.0%	56.0%
	Neutral	Count	0	6	1	7
		% of Total	.0%	24.0%	4.0%	28.0%
	Disagree	Count	0	0	4	4
		% of Total	.0%	.0%	16.0%	16.0%
Total		Count	14	6	5	25
		% of Total	56.0%	24.0%	20.0%	100.0%

Table 1: Cross Tabulation of Age with Ease to use HMIS application for Clinical Practice

Interpretation

Maximum number of respondents were of the age group of 25-35 years i.e. 56% , 24% of respondents were in the age group of 35-45 years and 20% of respondents are of the age group of 45-50 years.

And, from cross tabulation it could be said that with increasing age, it would be difficult for the doctors to use HMIS application for Clinical Practice. And for the users of the age group between 25-30 years would easily adapt the HMIS application for Clinical Practice.

-

Correlations

		Can HMIS increases work efficiency?	Does HMIS application make you work more effectively?
Can HMIS increases work efficiency?	Pearson Correlation	1	.659**
	Sig. (2-tailed)		.000
	N	25	25
Does HMIS application make you work more effectively?	Pearson Correlation	.659**	1
	Sig. (2-tailed)	.000	
	N	25	25

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2:Correlation table

Hypothesis set to test the correlation between Knowledge and Attitude parameters of users is as follows:

H_0: Effective working with HMIS is related to increase in efficiency of work.

H_1: They are not related

Interpretation

The Pearson Co-relation value is .659 which is towards 1 thus there is a correlation between the 2 variables.

And there is positive co-relation between the two i.e. they are directly related to each other.

Thus If there is effective working with HMIS then it leads to increased efficiency of work.

-

Correlations

		Do you find it easy to use HMIS application for Clinical Practice?	Does HMIS application makes you feel tiered and exhausted?
Do you find it easy to use HMIS application for Clinical Practice?	Pearson Correlation	1	-.846**
	Sig. (2-tailed)		.000
	N	25	25
Does HMIS application makes you feel tiered and exhausted?	Pearson Correlation	-.846**	1
	Sig. (2-tailed)	.000	
	N	25	25

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3: Correlation table

H_0: Feeling of tiredness in using HMIS is related to ease in use of HMIS in clinical practice

H_1: It is not related

Interpretation

As the Pearson Correlation value is .846 which is towards 1 so there is a relation between the two variables.

And there is a negative relation between the 2 variables i.e. they are indirectly related to each other i.e. Thus if one increases other decreases

If the feeling of tiredness and exhaustion in use of HMIS increases then it would decrease the use of HMIS application for clinical practice.

-

Correlations

		Can HMIS reduce the medication errors?	Can HMIS help in assuring quality and patient satisfaction?
Can HMIS reduce the medication errors?	Pearson Correlation	1	.706**
	Sig. (2-tailed)		.000
	N	25	25
Can HMIS help in assuring quality and patient satisfaction?	Pearson Correlation	.706**	1
	Sig. (2-tailed)	.000	
	N	25	25

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4: Correlation table

H_0: Use of HMIS in reducing medication Errors is related to assuring quality and patient satisfaction.

H_1: They are not related

Interpretation:

The Pearson Correlation value is .706 which is towards 1 thus the two variables are related to each other.

And there is a positive correlation between the two variables i.e. there is direct relationship between them.

Thus if Use of HMIS reduces medication errors then it would help is assuring quality and patient satisfaction.

8.5 DISCUSSIONS

The questionnaire was designed using 1 to 5 interval scale with Strongly agree to Strongly disagree the two endpoints. If correlation between knowledge, attitude and behavior of a user is positive then they get adapted to HMIS application quickly and easily. And if correlation is negative then it would be difficult for the users to get adapted to HMIS application in clinical practice.

And after the study is was found that age is also one of the factors which helps the user to get adapted to change in the process of clinical practice. It was found that the people of younger age group can adapt HMIS application in their clinical practice while of an older age group are reluctant in using an IT application for clinical practice.

8.6 CONCLUSIONS

The maximum numbers of respondents were agreeing in the use of the HMIS application for their clinical practice. And also it is necessary to study the user perspective towards an IT application. We can also say that parameters like knowledge, attitude and behavior help in understanding the user perspective for an IT application among healthcare sector.

8.7 LIMITATION S

1. Small sample size.
2. The maximum respondents were of age group of 25-30 years, older age group's responses were not studied.
3. Study was carried out among doctors, but other healthcare professionals also use HMIS.
4. No authentication as the survey was carried out by sending questionnaire on mail.

8.8 RECCOMENDATIONS

1. Follow-up studies with focus groups, user interviews, or observations would provide a more detailed understanding of physicians' needs could be carried out.
2. Future research could also address additional user groups within the healthcare system, such as nurses, administrators, or clerical staff.

REFERENCES

1. Smithson S., Hirschheim R. (1998). "Analyzing information systems evaluation: another look at an old problem", *European Journal of Information Systems*, Vol. 7, pp. 158-174.
2. George W. Odhiambo-Otieno, Wilson W.O. Odero, Department of Health Management, Faculty of Health Sciences, School of Public Health, Moi University; March 2005; Evaluation criteria for the district health management information systems: lessons from the Ministry of Health, Kenya
3. National tele health center; University of the Philippines Manila*; the Health Sciences Center*.
4. Https://wiki.openmrs.org/display/docs/Managing+Person+Attribute+Types
5. Udai Singh, Ashutosh Pandey, Amit Kumar ;Testing & Integration Issues in implementation of Advanced Health Information Management System
6. Gap Analysis Document (GAD) version – 10.0.0.1, Post Graduate Institute of Medical Education & Research (PGIMER).
7. H.C. KIMARO* & H.M. TWAAKYONDO, *University of Dar es Salaam, Department of Computer Science, Dar es Salaam, Tanzania:* Analyzing the hindrance to the use of information and technology for improving efficiency of health care delivery system in Tanzania; Tanzania Health Research Bulletin 7, September 2005
8. Angelo S Nyamtema; Bridging the gaps in the Health Management Information System in the context of a changing health sector; Nyamtema BMC Medical Informatics and Decision Making 2010
9. Health Research for Action: Review of the Health Management Information System HMIS/MTUHA. 2000, 136.
10. Ministry of Health of the United Republic of Tanzania: Health Management Information System: Implementation plan 1992-1996. MOH, Dar es Salaam 1993.
11. Smith M, Madon S, Anifalaje A, Malecela M, Michael E: Integrated health infomation systems in Tanzania: experiences and challenges. EJISDC 2008, 33:1-21.
12. Dillon, A., and Morris, M., G., (1996). User acceptance of information technology: Theories and models. Annual Review of Information Science and Technology 31:3-32.
13. Davis, F., D.,(1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Infromation Technology, *MIS Quarterly*, September, 1989, 13, 3: 319-340

APENDIX 1

QUESTIONAIRRE FOR PRE –IMPLEMENTATION EVALUATION

We are Health IT management students at International Institute for Health Management and Research (IIHMR), Delhi, doing this study on pre-implementation process flow and time taken at each step. This questionnaire is for study purpose only and data will be kept anonymous.

Q1. What are the various process flows in the OPD and IPD?

OPD Processes	IPD Processes
a. New Patient Registration	a. Admission Process
b. Old Patient Registration	b. Discharge Process
c. Emergency Registration	c. Medication Administration
d. OPD Consultation	

Q2. What is the time taken at each process?

a. Staff Response

b. Patient Response

APENDIX 2

Check list before testing the application

- Change the identifier prefix for respective hospital- The identifier prefix must reflect the name of the hospital that the customization is for, for example RHK for Regional Hospital Kullu, PMCH for Patna Medical College and Hospital

- Upload the xml files for address, OPDs, referrals- (write about what an xml file is). These are specific details of the hospital. In case of address, the district /tehsils from within the states, the names of the OPDs and referrals from, and to should be added in the form of an xml form. Alternately the OPDs and referrals can be mapped under a concept called OPD, and referrals can similarly be mapped.

- Make sure registration slips are ready with respective investigations and logo for particular hospital- The logo of the hospital, or the state government or health society, or any governing body that the hospital comes under must be included for proper identification and branding

- Make sure all person attributes are there(in administration manage person attribute types)

- In address field, the default district should be related to the respective hospital- Statistically, most of the visitors to the hospital will be from the district /tehsil that the hospital is situated in, and this must be the default as this will be used most often from the dropdown. Also, if personal details are unavailable, the registration clerk will keep the default district as the one that the hospital is in

- All OPD and IPD departments should be created with respective diagnosis and procedures(administration-hospital core)

- Make sure that in billing hierarchy, the investigation prices should be equal to investigation prices in manage billable services (administration) - also try to manually tally with the total bill from the report. This must be done to avoid any errors, as the daily cash reports, and the money collected depend on the correct and accurate entry of prices of services in the hospital billing hierarchy

- Make sure that in the laboratory, all investigations' ranges and units are getting printed in the patient report. Ranges and units may change according to each hospital; therefore these must be scrutinized before entering them into each investigation in the concept dictionary. (Write under what these are put, in the concept dictionary, under lab/range)
- Create laboratory role and department with sub labs for working of lab module, and make sure the proper role has been assigned
- Create radiology role and department with radiology investigations for working of radiology module , and make sure the proper role has been assigned
- Make sure default form should work for all investigations before making forms- Unless the default form works, individual forms cannot be created for specific tests
- Make sure in the global properties the x-ray default form id should be equal to form id in the address (x-ray default form in manage forms, see the ID in the address field)
- The default template should come for all investigations except antenatal
- Make sure in template the radiologist signature should be for respective hospital
- Create main store role and create store in inventory for working of inventory
- Create sub store role (e.g. pharmacy) and while creating sub store in inventory make sure the parent should be main store for sub-store. If the parent isn't the main store, all sub-stores will appear identical to the main store (receipt drugs etc……)
- Check manage global properties
- Paste BB forms, check BB concepts (Boolean to data type/coded)
- Create roles and users
- Radiology, laboratory (as system developer)

APENDIX 3

QUESTIONAIRRE

TO STUDY THE USER PERSPECTIVE FOR HMIS

We are Health IT management students at International Institute for Health Management and Research (IIHMR), Delhi, doing this study on 'User perspective for HMIS'. This questionnaire is for study purpose only and data will be kept anonymous.

Details of the Respondent
Name of the Respondent:_____
Age: **Sex: Male / Female**
Qualification: Intern / Graduate / Post Graduate / Doctorate
How many years of Clinical Experience: _____

Basic Computer Awareness:

BC1. Do you use computer in professional life?

Yes No

BC2. Do you find difficulty in using computers?

Yes No

BC3. Do you think IT applications are useful in Clinical Practice?

Yes No

BC4 Have you ever heard of Hospital Management System?

Yes No

Practice

P1 Do you keep track of Patient's Registered in the clinic?
Yes No

P2 Is the appointment scheduling of follow up cases done manually?

Yes No

P3 Have you used HMIS previously for any task?

Yes No

1=Strongly Agree 2=Agree 3=Neutral 4=Disagree 5=Strongly Disagree

1 Can HMIS increases work efficiency?

1 2 3 4 5

2 Can HMIS help in reducing duplication of medical records?

1 2 3 4 5

3 Can HMIS reduce the medication errors?

1 2 3 4 5

4 Does HMIS Application make you feel a sense of competence?

1 2 3 4 5

5 Does HMIS application make you work more effectively?

1 2 3 4 5

6 Does HMIS application makes you feel tiered and exhausted?

1 2 3 4 5

7 Do you find it easy to use HMIS application for Clinical Practice?

1 2 3 4 5

8 Can HMIS help in scheduling appointments more effectively?

1 2 3 4 5

9 Can HMIS help in assuring quality and patient satisfaction?

1 2 3 4 5