

Hospital Management System for The Mayo Clinic



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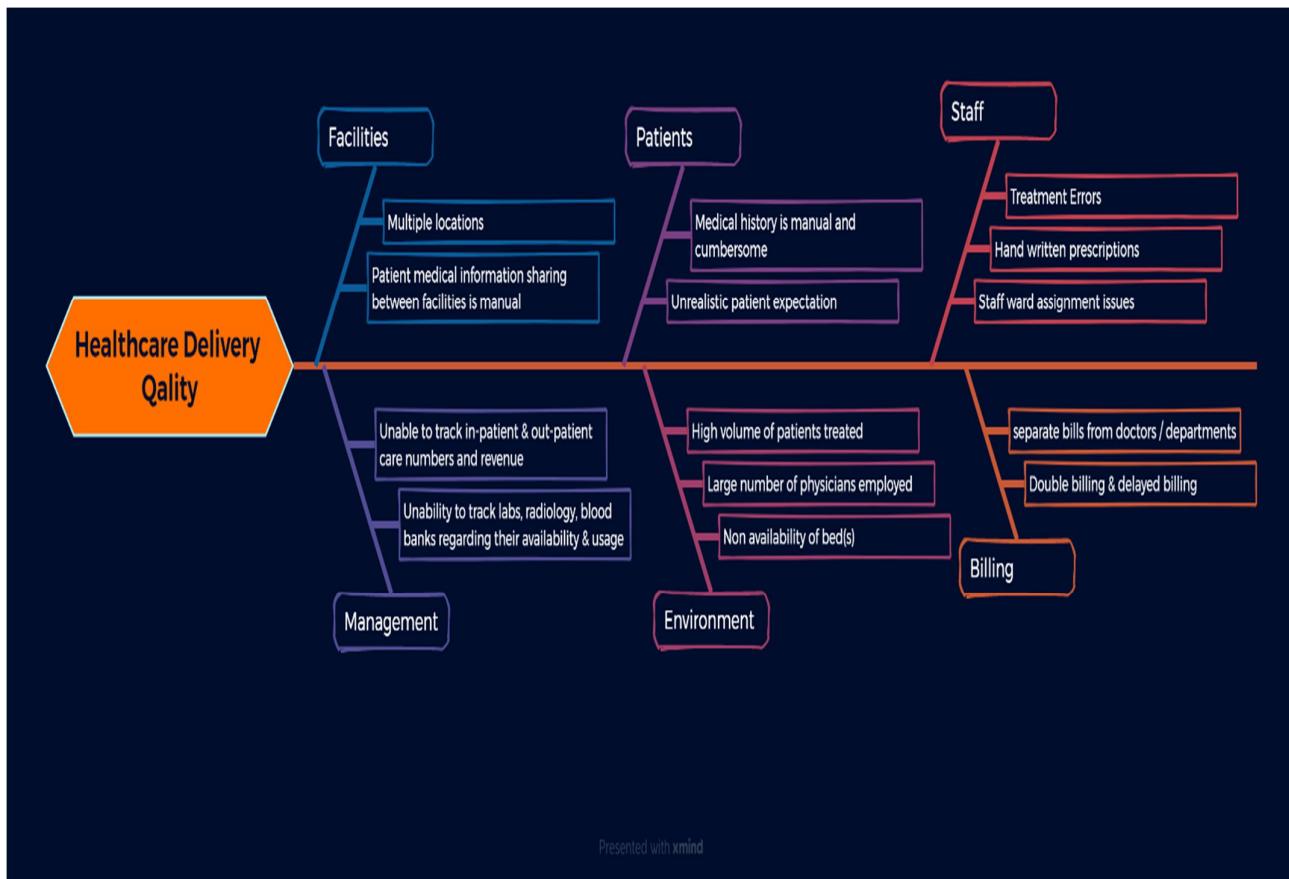
1) Introduction

The Mayo Clinic is an American nonprofit academic medical center currently based in three major locations, Rochester, Minnesota; Jacksonville, Florida; and Scottsdale, Arizona focused on integrated patient care, education, and research. Mayo Clinic holds the number 1 rank among hospitals in the United States.

2) Overview

It was opened on the 30th of September 1889. Over the years it grew and has increased the size of its premises and the number of doctors it employs. The vast number of patients it treated made management of such a huge hospital an arduous task. The paperwork and storing of all patients' records was becoming unmanageable. It was then the management of the hospital decided to invest money in a hospital management software.

3) Fishbone Diagram of Mayo Clinic Healthcare Delivery Quality Issue



4) Business Analysis Core Concepts Model

a) Need

- i) There is a need for a Hospital Management System (HMS) that is secure and can be used by patients outside the hospital system to view and book available doctors and appointments

- ii)** There is a need for a HMS that can be used by all departments within the hospital system for efficient tracking of employees, facilities (viz. beds), the patients' treated there and their clinical history and details.
- iii)** There is a need to separate clinical information as non-medical staff should not have access to patient medical data as per Government regulations.
- iv)** To make effective and timely decisions in the care and treatment of patients, and in keeping with regulations it is necessary that patient electronic health records are stored securely and easily and quickly retrievable.
- v)** There is also a need for a system that generate patient billing and various reports about patient care, diagnostic results and hospital managerial and operational information like patient resource allocation, patient tracking, staff management, bed vacancy, revenue, and expenses

b) Change

- i)** As the hospital system grows in the number of premises it operates and people it employs and treats, the current arduous and unmanageable manual process of patient care management and hospital management necessitates that the employees and management change how they operate.

c) Solution

- i)** A Hospital Management System consisting of the following main components – appointment scheduling, patient management, clinical information system, staff management and reporting.
- ii)** The system will store patient clinical and medical records, show availability of beds and scheduling of ward workers and nurses, manage patients' billing, scheduling of doctor's appointments, and will bring about coordination among the different departments.

d) Context

- i)** The expansion of the hospital as it increases the size of its premises, the number of facilities it operates, the number of doctors, nurses and other medical and non-medical staff it employs and the need for patient data security and employee management in keeping with Government regulations

e) Value

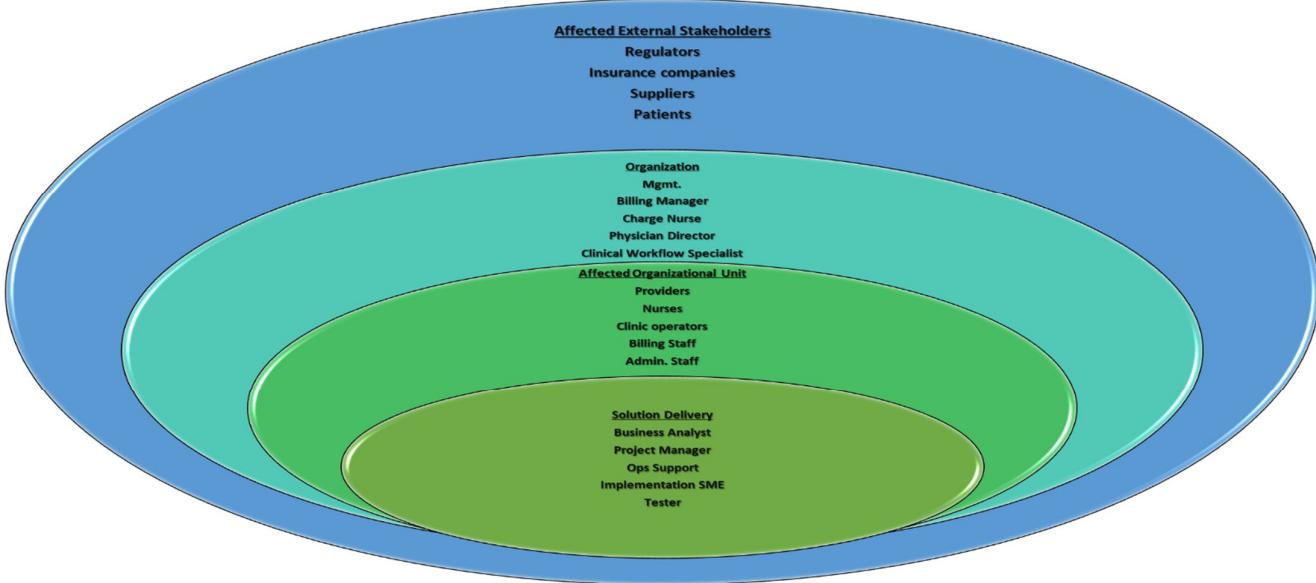
- i)** The tangible value of the Hospital Management System will be a reduction in the operating costs of the hospital as paperwork will be mostly eliminated and the manpower required to maintain all this is significantly reduced.
- ii)** Patients will be able to schedule appointments online based on their doctor availability saving time. Doctors, nurses, and other medical staff will have easy and secure access to patient data and past medical history and treatments.
- iii)** Hospital administration will be able to track bed occupancy and hospital management will have access to rapid information that will aid in better decision-making
- iv)** The intangible value of the HMS will be a better customer-hospital relationship and customer satisfaction. Patients get proper services, and patient billing is streamlined.

5) Stakeholders

| ACTOR | What he can do on the Software Created |
|----------------------|---|
| Administrative staff | <ul style="list-style-type: none"> ✓ Create patient unique ID and enter personal information ✓ Allocate beds and end to end process from admission to discharge ✓ Billing for OPD, IPD lab or radiology services |

| | |
|-------------------|--|
| | <ul style="list-style-type: none"> ✓ Maintain cash/ credit scrolls for themselves ✓ Create/access occupancy and Payer reports ✓ Bed allotment and shifting logs ✓ Update discounts and remarks ✓ Mark listing of patients such as VIP or HOT listed |
| Doctors | <ul style="list-style-type: none"> ✓ Able to mention treatment details and patient condition ✓ Enter medications or tests & lab services that will directly be sent/reflected in concern departments ✓ Get notified at time of emergency |
| Nurses | <ul style="list-style-type: none"> ✓ Able to see on-going treatment of patient ✓ Log in vitals and indent medicines as and when needed ✓ Notify Doctors for condition of patient ✓ Maintain their attendance and work logs |
| Senior Management | <ul style="list-style-type: none"> ✓ He/She can see Total occupancy and generate daily revenue reports ✓ They can access each patient's location (bed occupied) with doctor details and current treatment (Medical/Surgical) for admitted patients ✓ One can access complete Patient information like name, contact no, address etc. on single window ✓ Software will enable them to keep a check on daily errors by staff and maintain a log for same ✓ Logs for discounts and remarks will be maintained and accessible ✓ Doctors' appointments and revenue generated through OPDs. ✓ Total number of OPD patients and admitted patients ✓ Which doctors generate the maximum revenue ✓ Total amount of earnings through OPD and admitted patients ✓ Total amount of earnings generated through laboratory and radiology |

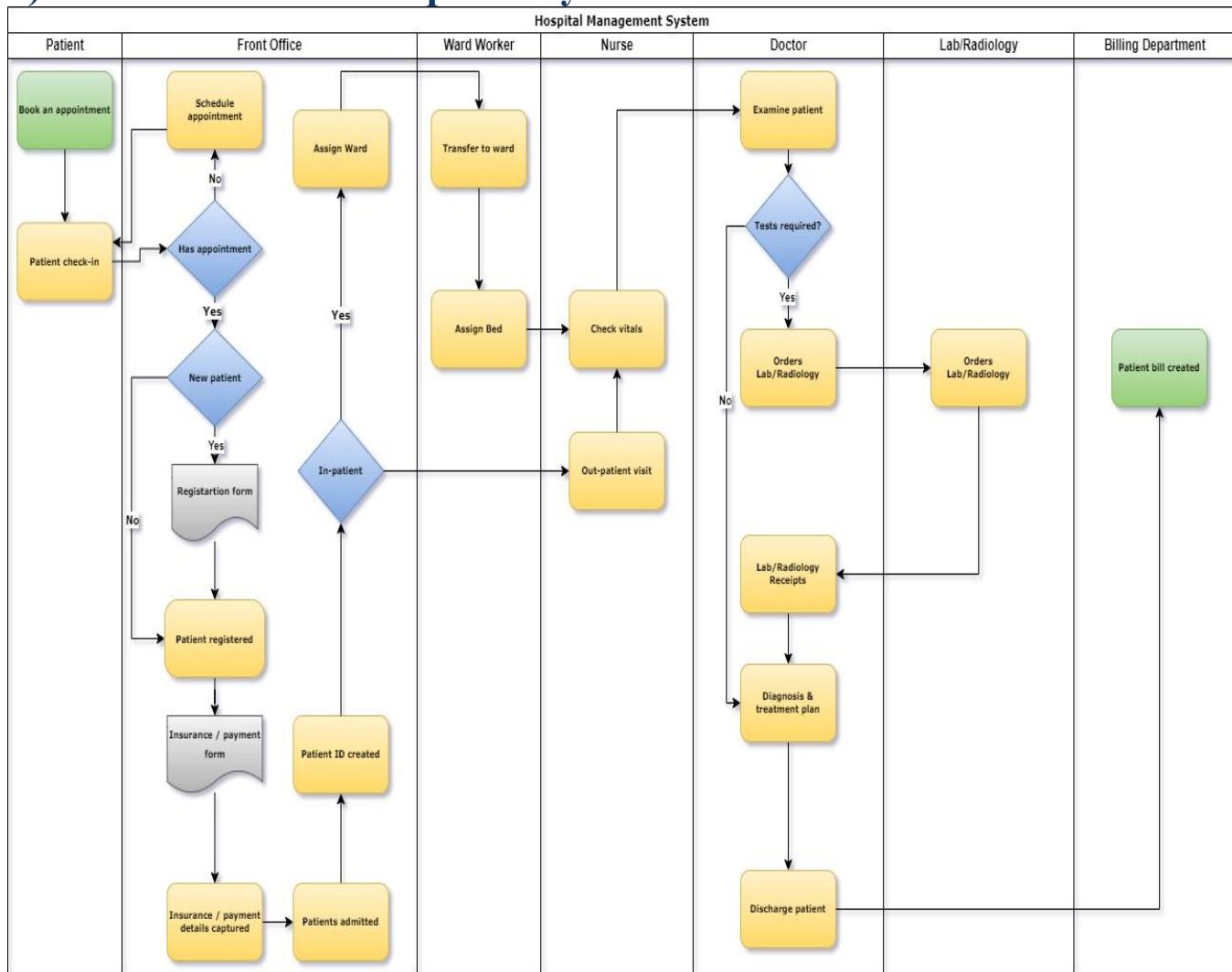
6) Identification of Stakeholders



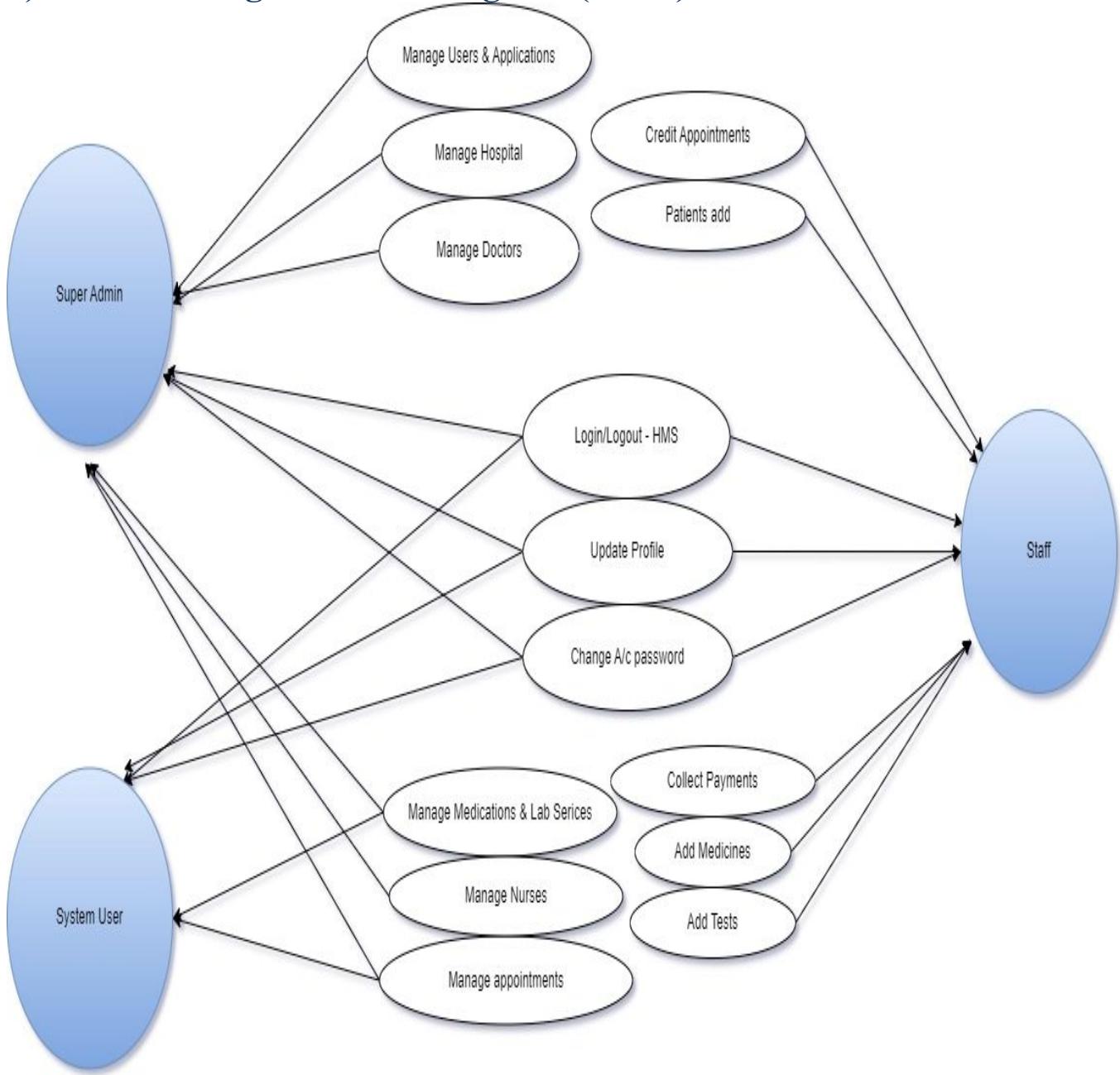
7) Scope

- a) The proposed HMS will be used to get all relevant information from the patients and
- b) data will be stored for future use.
- c) The current system is paper based and too slow which is unable to provide updated
- d) information/lists of patients within a reasonable timeframe. Intention is to reduce
- e) overtime pay and increase number of patients that can be treated accurately.
- f) Hospitals and healthcare centres have undergone a change for its betterment and so for smoother operations of Daily functions like patient registration, monitoring blood bank, managing admission and overall management of various departments can be easily performed with higher accuracy after the installation of hospital software.
- g) The modules of hospital management software must be user-friendly and easy to access.
- h) It shall have a common user-friendly interface having several modules. The officials can
- i) utilize these modules in their processes without any hassle and make the best possible use of hospital management system.
- j) The system will provide excellent security of data at every level of user system interaction and also provide robust and reliable storage and backup facilities.

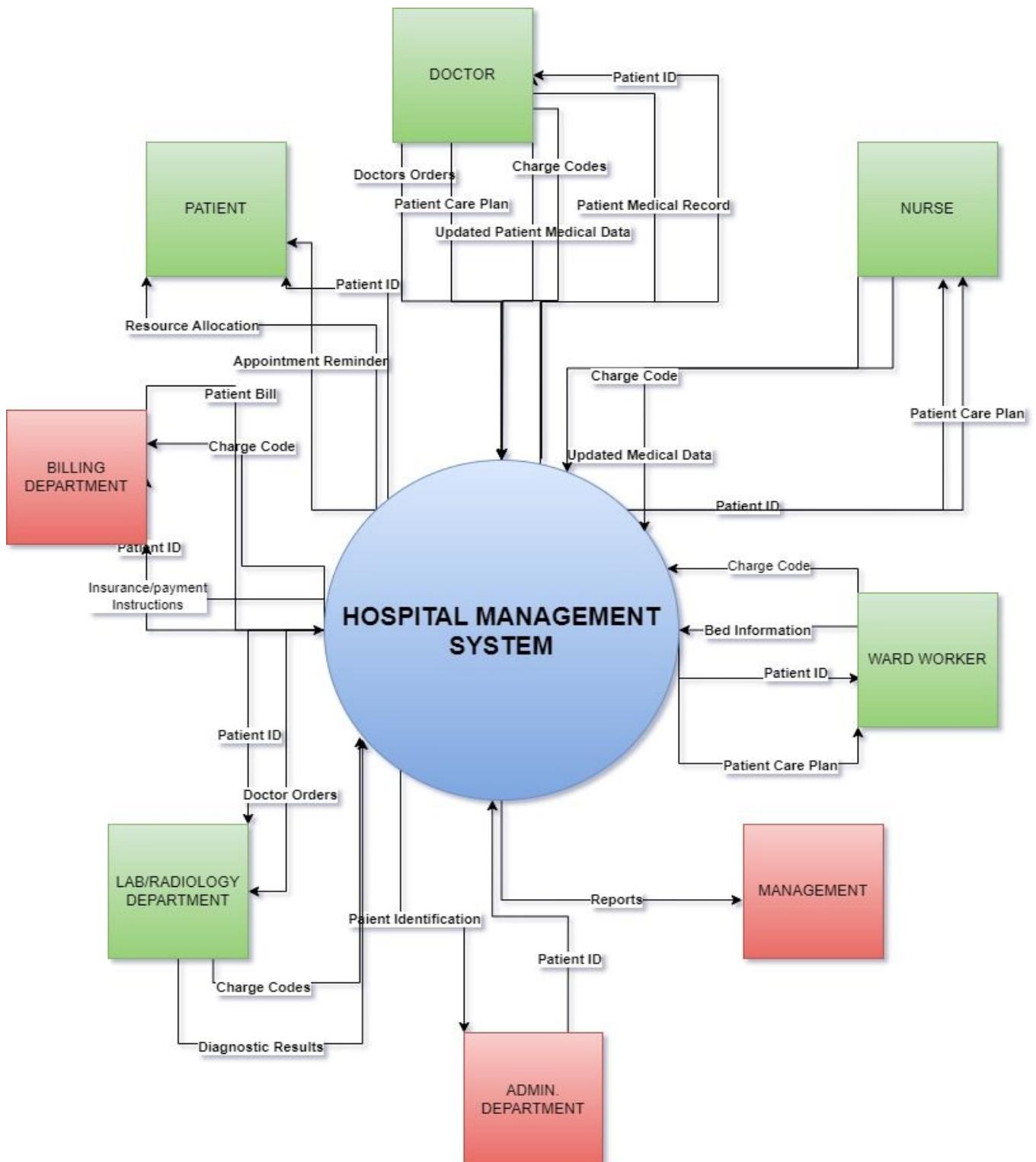
8) Workflow of The Proposed System



9) SCOPE using Use Case Diagram (UML)



10) Context Diagram



11) In Scope

a) Patients' Appointment Management –

- the timings of all the hospital doctors to be displayed on the website. Patients can select the doctor they would like to visit based on the appointment slot available for that doctor. The system shall book the appointment for that patient with the doctor selected.
- OPD scroll for Hospital Staff will also be available in OPD Module.

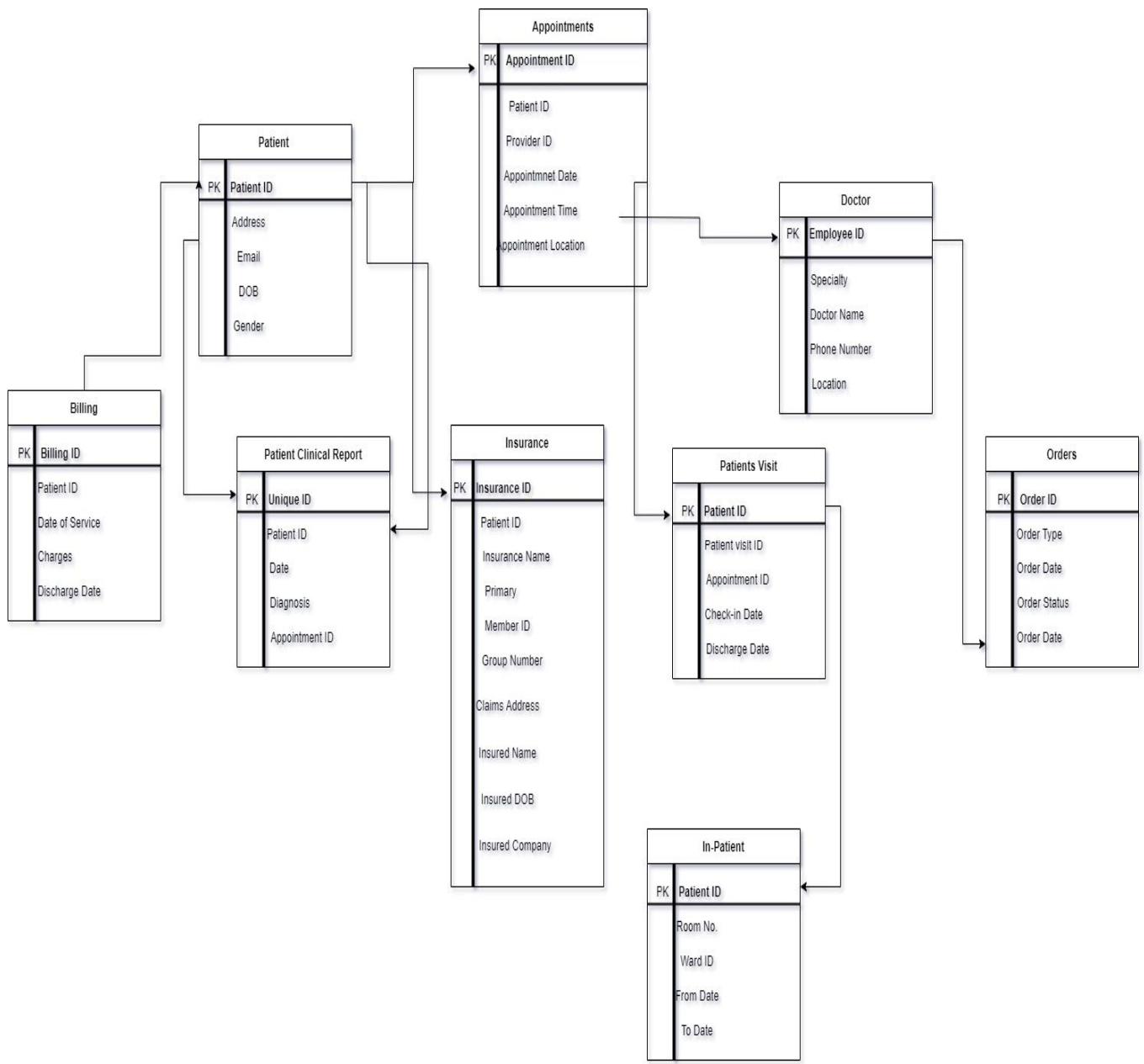
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| b) Appointment Reminders - |
| i) system shall send email and SMS reminders to the patient one day prior to the appointment date to remind the patient of the appointment. |
| c) Patient Registration- |
| i) when a new patient comes to the hospital, they are registered in the system. The system can store all medical records of the patient and their medical history. The registration staff will give each patient a patient ID. This ID will be used by the patient throughout their stay in hospital. The patient ID will be deleted from the system when the patient checks out. |
| ii) Doctors will be able to enter patient treatment details and diagnosis and see test reports, create discharge summaries, prescriptions. |
| iii) Doctors can modify and update their schedules of appointments which will directly be notified to patients. |
| iv) IPD module will be subdivided into Emergency Module as well where in Bed allotment IP billing and patient admission process will be done. |
| d) Bed Occupancy - |
| i) it keeps tracks of all the beds in the hospital. It will show the list of all the occupied and unoccupied beds in the hospital. Every 6 hours, the person in charge for the hospital floor will update the bed occupancy. |
| e) Billing – |
| (1) HMS will total up all the expenses of a patient at one time and produce a complete bill at the end of the consultation or at discharge. This will save time and effort for each department as they need not produce separate bills for a single patient. |
| (2) OPD Billing Module where in patient registration, details will be fed along with billing for lab and pathological test, Doctor Consultation and other procedures. |
| f) Laboratory, Blood Bank, And Radiation and other Departments – |
| (1) if a doctor needs to prescribe any tests for any patient, he will enter the same in HMS. This will be received by the laboratory or radiation department directly. The patient's tests are done, and the reports are uploaded by the department in the HMS. The doctor can log in the system and enter the patient ID and view them directly. This eliminates the need of paper reports and retrieval is also easy. |
| (2) Lab staff can enter reports and receive notifications whenever an investigation is suggested in case of IP. |
| (3) Pharmacy module will maintain logs for stocks and provide medications to IP as well as OP Patients as when required and generate daily reports for same |
| g) Reports – |
| Reports are generated from the HMS for senior management to have a clear understanding on the hospital's revenue, expenses, bed occupancy, and other details. Management would like the following reports: |
| (1) Bed occupancy for each day |
| (2) Doctors' appointments and revenue generated through OPDs. |
| (3) Total number of OPD patients and admitted patients |
| (4) Which doctors generate the maximum revenue |
| (5) Total amount of earnings through OPD and admitted patients |
| (6) Total amount of earnings generated through laboratory and radiology |
| (7) Any modifications to be done pertaining to patient details can be done in OPD module along with details of invoices and revenue, discount and other Reports will be updated here. |
| h) Staff Management – |
| (1) It stores the names and timings of the nurses and ward boys on duty with their respective ward numbers. |

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| (2) A separate module for nursing doctors and lab will be there where in each Nurse will be able to see Line of treatment for patient, enter vitals log and see medications for patients. |
| (3) Nurses can intimate doctors in case of emergency and access lab reports as well Manage Users and Full Applications |
| i) Instructions For Patients – |
| (1) all the instructions given by the doctors for the nurse to follow for each patient are entered in the system. While conducting patient care the nurse just looks up the system to understand which medicine or what line of treatment, they need to give the patients. |
| j) Insurance – |
| (1) for patients that have insurance, all the insurance details are to be stored in the system for claim processing. |
| (2) Another sub division in IP module will be for Insurance where in TPA Patient details will be reflected and processing for them would be done. |

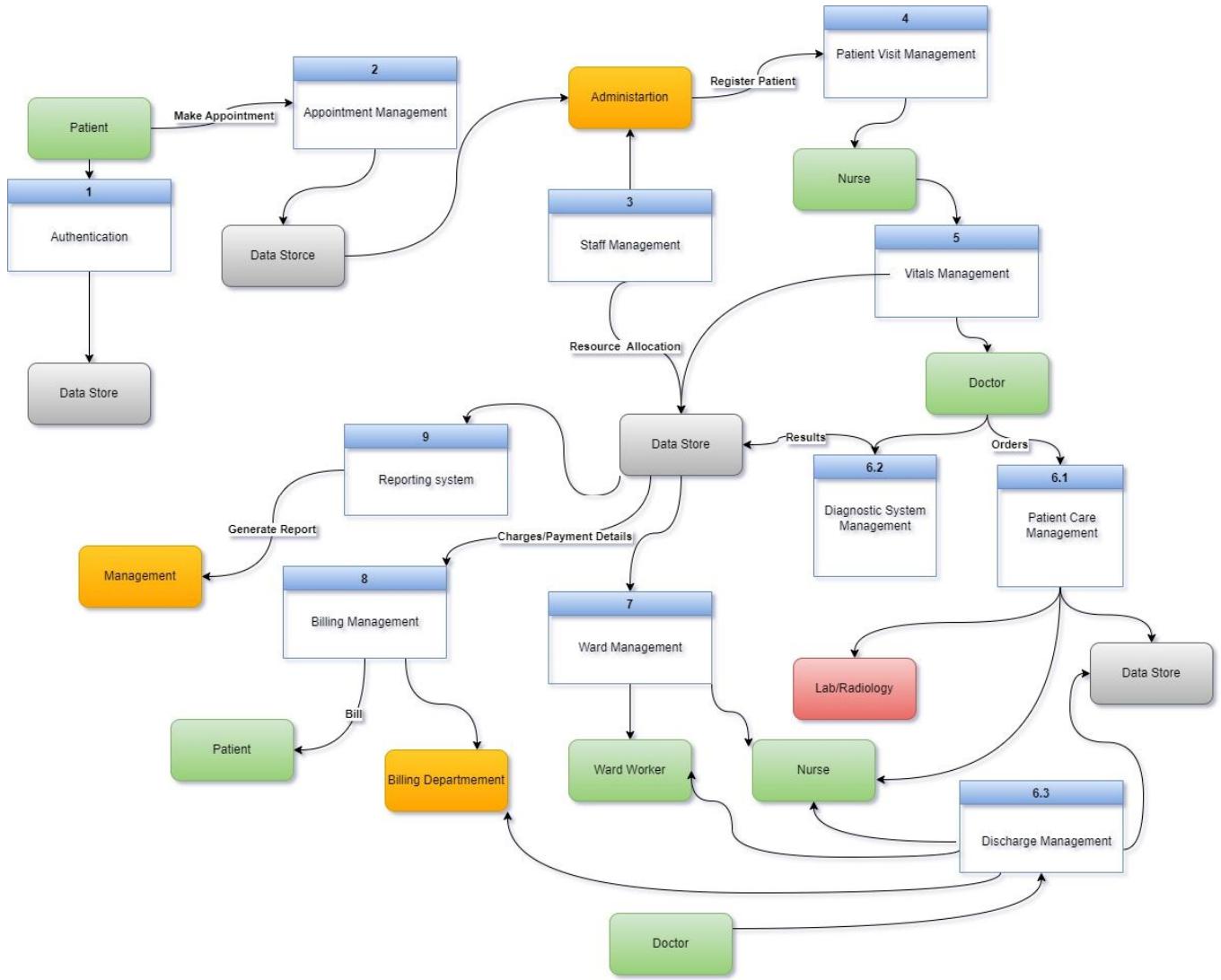
12) Out of Scope

- a) Educate Staff
- b) Generate risk reports
- c) Patient Portal
- d) Emergency Department Management
- e) Pharmacy Department Management
- f) Surgery Department Management
- g) Patient Online Payment

a) ER Diagram for HMS



b) Data Flow Diagram



c) Flow chart for patient admission



13) Requirements

a) Functional Requirements

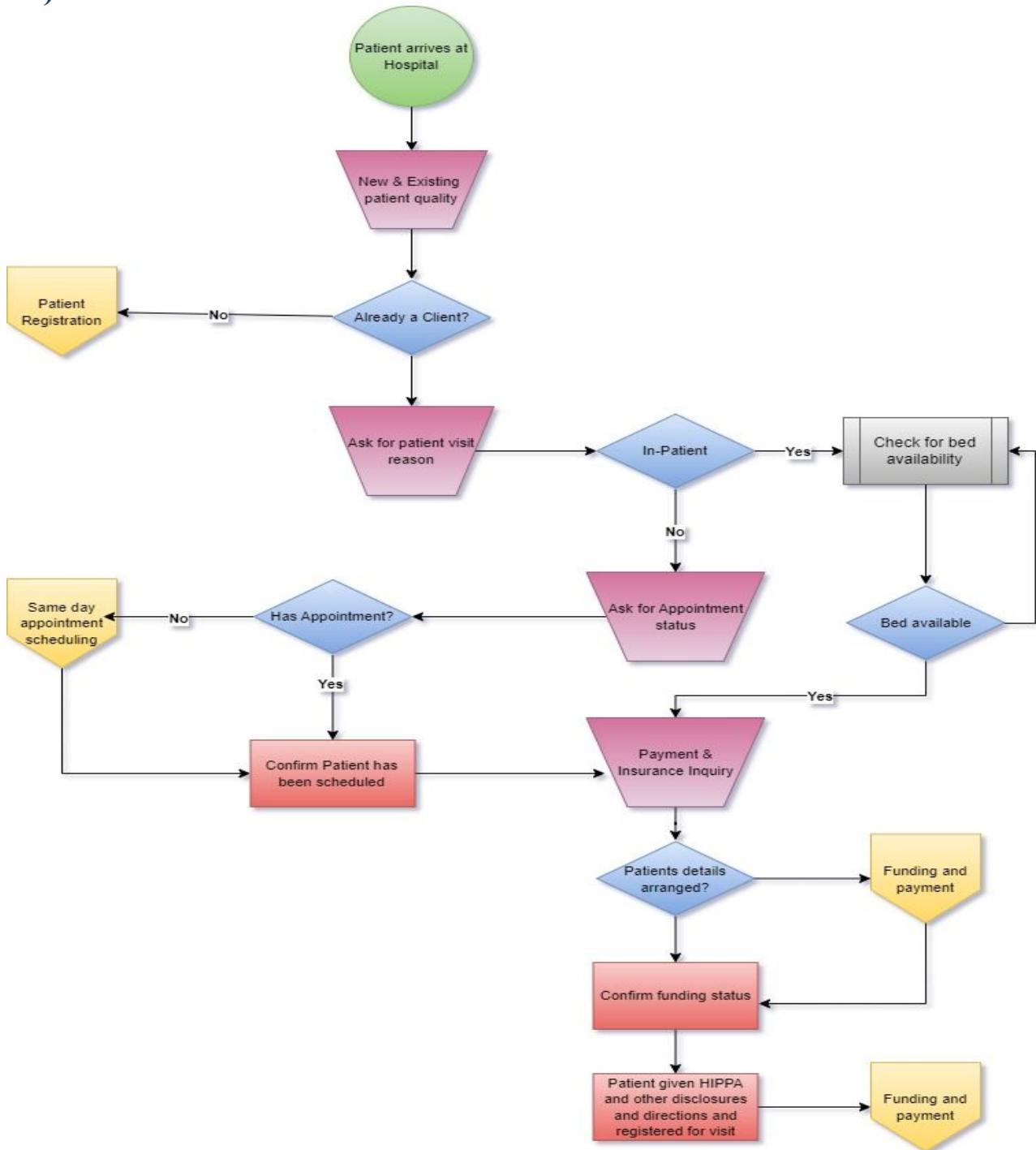
- i) The system must allow external users i.e., patients to create an account in the HMS using a valid email address and password.
- ii) The system must allow users to log into their account by entering their email and password.
- iii) The system must allow users to reset their password by clicking on "I forgot my password" and receiving a link to their verified email address.
- iv) The system must track outpatient appointments, inpatient visits and diagnostic orders
- v) The system must allow front desk to create new patients in the system.
- vi) The system will store some required data for every patient like phone number, their first and last name, a unique patient id, driver's license number, address, country, city, and other required information
- vii) The system must allow back office to update patient insurance and payment/billing details
- viii) The system must create a unique id for each patient visit that enables the system to track the patient throughout the patient visit
- ix) The system must generate a visit record on every patient with details like individuals name,
- x) Phone number, bed number, the medical professional's name whom it appoints, ward name, and other information as appropriate.
- xi) The system must delete the unique patient visit id when the patient is checked out or discharged from the hospital
- xii) The system must keep tracks of all the beds in the hospital.
- xiii) The system must display the list of all the occupied and unoccupied beds in the hospital.
- xiv) The system must allow the ward manager to update the bed occupancy.
- xv) The system must store the names and timings of the nurses and ward boys on duty with their respective ward numbers.
- xvi) The system shall send email and SMS reminders to the patient one day prior to the appointment date to remind the patient of the appointment.
- xvii) The system must store all medical records of the patient
- xviii) The system must have a billing management system that will total up all the expenses of a patient for a patient visit at one time and produce a complete bill at the end of the consultation or at discharge.
- xix) The system must allow a doctor to prescribe tests for a patient sourced to them,
- xx) The system must store doctors orders' and these should be made accessible by the laboratory or radiation department directly.
- xxi) The system should store patient's tests results.

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| xxii) The system should allow the doctor to log in the system and enter the patient ID and view the test results directly. |
| xxiii) The system shall store all the doctor's instructions for a patient for a patient visit. |
| xxiv) The system shall allow the nurse to log into the system and access the doctor's instructions for a patient and mark them as complete if necessary. |
| xxv) For patients that have insurance, all the insurance details must be stored in the system for claim processing. |
| xxvi) The system, shall generate the following reports for management users: |
| (1) Bed occupancy for each day |
| (2) Doctors' appointments and revenue generated through OPDs. |
| (3) Total number of OPD patients and admitted patients |
| (4) Which doctors generate the maximum revenue |
| (5) Total amount of earnings through OPD and admitted patients |
| (6) Total amount of earnings generated through laboratory and radiology |

b) Nonfunctional Requirements

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| i) Maintainability |
| (1) The system must use the MySQL Database. |
| (2) The system must be developed for use on Windows 2016 operating system |
| (3) The system must be a web-based application |
| ii) Compliance and Security |
| (1) Database security must meet HIPPA requirements. |
| (2) The system must comply with all state and federal regulations regarding personal identifiable information. |
| (3) The system must comply with all state and federal regulations regarding personal health Information. |
| (4) The system must comply with all state and federal regulations regarding personnel management. |
| (5) Any users who make use of the system should have a username and password. |
| iii) Performance |
| (1) The system shall give responses in one second |
| iv) Scalability |
| (1) The system must support 500 concurrent users at a time. |
| v) Reliability |
| (1) The system must track every error and maintain a log of all the errors. |
| (2) The system shall be available a hundred percent of the time |
| vi) Usability |
| (1) The user interface should be simple and self-explanatory. |

14) Patients' Admission Process



15) Screen Wireframes

a) Login page

Log in to patient portal

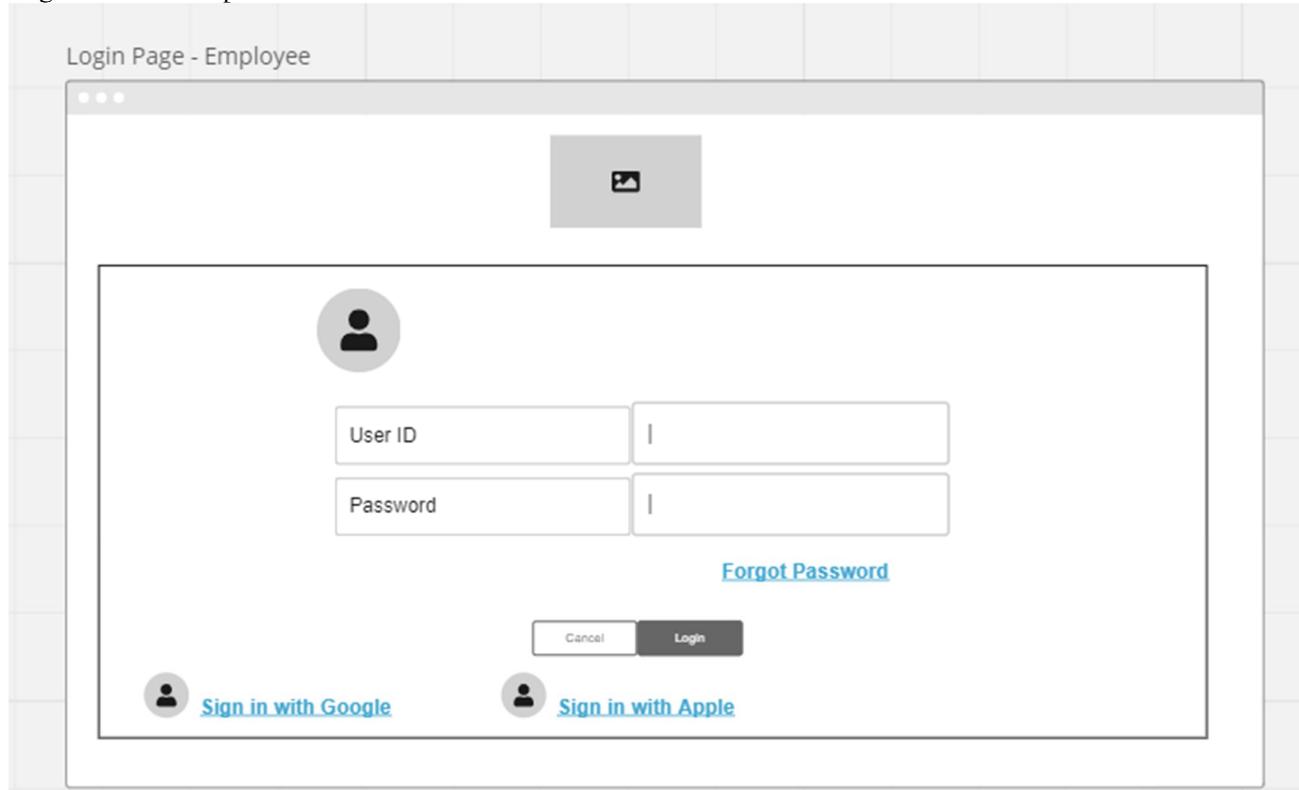
Username

Password
 [SHOW](#)

Log in

[Create your account](#)
[I need help logging in](#)

The Login Page will have Mayo Clinic's Logo on top right Corner with User ID where user will fill in Patient ID to Login to HMS and passwords.



The Login Page will have Mayo Clinic's Logo on top right Corner with User ID where user will fill in employee ID to Login to HMS and passwords as provided to them.

b) Landing page



c) Main page

Main Page

Patient Login Pay My Bill Find a Doctor Careers Our Services Search

The #1 hospital in the nation

You know where to go. We provide answers to your health questions

[Learn More](#)

About Us

Mayo Clinic is a nonprofit organization committed to clinical practice, education, and research, providing whole-person care to everyone who needs healing. Here, experts solve the biggest health care challenges together.

Our Facilities

Rochester, Minnesota Jacksonville, Florida Scottsdale, Arizona

d) Patient Registration Page

Patient Registration Page

The screenshot shows the Mayo Clinic Patient Registration Page. At the top, there is a navigation bar with links for Patient Login, Pay My Bill, Find a Doctor, Careers, Our Services, and a search bar. The main section is titled "Patient Information" with a sub-instruction: "In this section, we'll gather basic information to create your medical profile". It contains fields for Name (First, Middle, Last), Gender, Date of Birth (with a calendar icon), Address (Street Address 1, Street Address 2, City, State, Zip, Country dropdown), Email (Type email here), and Phone numbers (Home Phone, Mobile). Below these fields is a note: "Note: By selecting the "Next" button, I can certify that I am the above named individual, that the personally identifying information is true and accurate." A blue "Next" button is at the bottom.

- e) Post login user will be able to see this page where in He/She will have to select which module they have to work in.
- i) If accessing OPD Admin Staff will further be taken to OP registration, billing page.
 - ii) If accessing IPD Admin Staff will further be taken to IP Module wherein they will be able
 - iii) to do admission registration, a lot beds, Select Payor (TPA), billing for admitted patients including Emergency
 - iv) In LAB testing services and reports for Radiology and Pathology will be available.
 - v) Doctors can enter treatment details and indent tests and other services.
 - vi) Nurses will be able to perform their tasks in Nursing module.
 - vii) Pharma related billing, medicine stocks will be taken care of this module.