CHENGDU UNIVERSITY OF TECHNOLOGY

Oxford Brookes University College

CHC6173 Software Engineering

Case Study for Coursework

HealthGuardian: Hospital Management System

Requirements Definition

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Abstract

This document is the requirements definition of a cloud-based application system called *HealthGuardian* for enhancing the healthcare experience for both patients and medical professionals. The document states the goal and objectives of the system, defines the scope of the system, analyses the target user types and their characteristics of digital literacy. It defines the functional and quality requirements for each user type as well as the required design features of the system.

1. Introduction:

In the rapidly evolving landscape of healthcare, efficient management of hospital resources and patient information is paramount. Hospital Management Systems (HMS) represent a crucial component in modern healthcare infrastructure, providing a comprehensive solution to streamline administrative, clinical, and financial processes within healthcare facilities. These systems are a testament to the convergence of cutting-edge technology and healthcare delivery, and they play a pivotal role in enhancing patient care, optimizing resource utilization, and ensuring regulatory compliance.

Hospital Management Systems are a category of software applications tailored to the specific needs of healthcare institutions, ranging from small clinics to large multi-specialty hospitals. They are designed to address the diverse challenges faced by healthcare providers, administrators, and support staff in their daily operations. These challenges include patient registration, appointment scheduling, electronic health records (EHR) management, billing and financial accounting, pharmacy management, inventory control, and more.

The development and implementation of a robust HMS demand a multidisciplinary approach, involving software engineers, healthcare professionals, and IT experts. Software engineering, in particular, plays a pivotal role in the design, development, testing, and maintenance of these systems to ensure their reliability, scalability, and security.

2. Type of Users:

The targeted users in the system are:

a) **Patient**: They are individuals who schedule appointments, view medical records, receive medical services, and make payments.
b) **Doctor or Physicians:** They are persons with medical degree & license who provide health care to patients, access patient records, diagnose medical conditions, prescribe treatments, and schedule surgeries.
c) **Nurse**: They are individuals who record patient vitals, administer medications, and update patient information.
d) **Hospital Managers**: They involve overseeing various administrative and operational aspects of the hospital to ensure its efficient and effective functioning
e) **Pharmacist**: They manage medication orders and dispensing medications to patients based on doctor's prescriptions.
f) **Receptionist**: They are hospital staff responsible for managing patient appointments, checking in/out patients, and maintaining patient information in the system.
g) **Laboratory technician staff**: They record and retrieve test orders, perform tests, and enter test results.
h) **System Operators**: System administrators who manage user accounts, ensure system security, and perform system maintenance tasks.

3. Functional Requirements:

3.1 Functional Requirement of Patient:

a) Login/Logout: The patient must login in order to verify its identity before accessing to the system by entering his username (or phone number) and password, and logout to terminate its session securely when he is done using the system. *(Priority: high)*

b) Register: Patients should be able to register their personal information, including real (name, phone number and photo), other information can be included such as date of birth, address, gender and email. *(Priority: high)*

c) Book an appointment: Patients should be able to request, schedule, reschedule, or cancel appointments with healthcare providers through the system. *(Priority: high)*

d) Medical History and Records Access: Patients should have access to their electronic health records (EHRs) and medical history, allowing them to view diagnoses, treatments, medications, and test results. *(Priority: medium)*

e) Prescription Requests: Patients should be able to request prescription refills or new prescriptions online, and the system should facilitate communication between patients and healthcare providers for this purpose. *(Priority: high)*

f) Billing and Payment: Patients should be able to view and pay their bills online, access billing statements, and review insurance claims and payments. *(Priority: high)*

g) Appointment Reminders and Notifications: The system should send appointment reminders and notifications about upcoming tests, procedures, or follow-up appointments to patients through various communication channels, such as email or SMS. *(Priority: high)*

3.2 Functional Requirement of Doctor:

a) User Authentication and Authorization: Secure login with role-based access to ensure that only authorized doctors can access patient data. *(Priority: high)*

b) Access to Patient Information: Doctors should have the ability to view and update patient records, including medical history, test results, and treatment plans. *(Priority: high)*

c) Manage Appointment Scheduling: doctors should be able to view and manage appointment schedules and can create, reschedule, or cancel appointments. *(Priority: medium)*

d) Manage Prescription: doctors can generate electronic prescriptions for medications. *(Priority: high)*

e) Order Tests: Doctors should be able to order diagnostic tests, laboratory work, and medical procedures. And receive and review test results electronically. *(Priority: high)*

f) Communicate with Patient: Secure messaging or communication with patients for follow-up and consultation. *(Priority: low)*

3.3 Functional Requirement of Nurse:

a) Login: Secure login to ensure that only authorized nurses can access patient data. *(Priority: high)*

b) Patient Information Access: Nurses can view and update patient records, including medical history, vital signs, and treatment plans. *(Priority: high)*

c) Patient Admission and Discharge: Nurses admit patients to their assigned beds and

Complete discharge procedures when patients are ready to leave. *(Priority: high)*

d) Give prescribed treatment to patient: they record and administer medications to patients, including dosage and timing. *(Priority: high)*
e) Record patient symptoms: Nurses record and monitor vital signs (e.g., blood pressure, heart rate, temperature) at specified intervals and set up alerts for abnormal vital sign readings. *(Priority: high)*

3.4 Functional Requirements of Hospital Managers:

a) User Authentication and Authorization: Secure login with role-based access to ensure that only authorized hospital managers can access patient data. (Priority: high)
b) Manage Users: Access to user management features to control access permissions and roles for hospital staff. *(Priority: high)*
c) Staff Management: It is a personnel management features for hiring, scheduling, training, and performance evaluations. *(Priority: high)*

3.5 Functional Requirements of Pharmacist:

a) User Authentication and Authorization: Secure login with role-based access to ensure that only authorized Pharmacist can access patient data. (Priority: high)
b) Medication dispensing: Pharmacists must accurately dispense medications to patients based on prescriptions provided by doctors, ensuring the correct dosage and medication form (e.g., tablets, capsules, liquid). *(Priority: high)*
c) Prescription Verification: Verify the authenticity of prescriptions, ensuring they are correctly written and signed by authorized healthcare providers. *(Priority: high)*
d) Inventory Management: Maintain an accurate inventory of medications and pharmaceutical supplies, monitor expiration dates, and reorder stock as needed to prevent shortages. *(Priority: high)*
e) Medication Information: Offer healthcare professionals accurate and up-to-date information about medications, including dosing, administration, and therapeutic considerations. *(Priority: high)*

3.6 Functional Requirements of Receptionist:

a) Patient Registration: Register new patients in the hospital system, collecting their personal information, contact details, and insurance information. *(Priority: high)*
b) User Authentication and Authorization: Secure login with role-based access to ensure that only authorized receptionist can access patient data. *(Priority: high)*
c) Schedule patient appointment: Schedule and manage patient appointments, including new appointments, rescheduling, and cancellations. *(Priority: high)*
d) Patient Check-In and Check-Out: Assist patients with the check-in process when they arrive at the hospital and facilitate the check-out process when they leave, ensuring accurate documentation. *(Priority: high)*
e) Medical Records Management: Request and retrieve patient medical records as needed for healthcare providers, ensuring records are kept confidential and secure. *(Priority: high)*
f) Receive payment: Accept payments from patients for services rendered, provide billing information, and issue receipts. *(Priority: high)*
g) Patient Information Updates: Update patient records with any changes in contact

information *(Priority: medium)*

3.7 Functional Requirements of Laboratory Technician Staff:

a) User Authentication and Authorization: Secure login with role-based access to ensure that only authorized laboratory technician staff can access patient data. (Priority: high)
b) Data Entry: the technician staff should be able to Record test name, results and data accurately into the laboratory information system. *(Priority: high)*
c) Instrument Troubleshooting: The staff can identify issues with laboratory equipment and instruments, and report them. *(Priority: low)*
d) Test Request Handling: Receive and review test requests or orders from doctors. *(Priority: high)*

3.8 Functional Requirements of System Operators:

4. User Authentication and Authorization: Secure login with role-based access to ensure that only authorized system operators can access patient data. *(Priority: high)*

a) Setup Hospital accounts: System operators should be able to set up hospital accounts for the hospital staff. *(Priority: high)*
b) Manage User Accounts: System operators can create, modify, delete user accounts for hospital staff (hospital managers, doctors, receptionists, nurses, pharmacists and laboratory technician staff) and reset their passwords. *(Priority: high)*

5. Required Design Feature:

5.1 Delivery of Functions:

The following subsystems should be developed:

- HealthGuardian Patient: to deliver functions for patients in the form of mobile app
- HealthGuardian doctor: to deliver functions for doctors in the form of mobile and desktop/web-based app
- HealthGuardian pharmacy: to deliver functions for pharmacist in the form of desktop/web-based app
- HealthGuardian Lab: to deliver functions for laboratory technician staff in the form of desktop/web-based app

5.2 Storage of processing data:

The following data should be stored:

- The Registration information of patients
- The Registration information of hospitals
- The registration of patients checks in/checks out
- The Registration information of hospital managers and hospital staff (doctors, receptionists, nurses, pharmacists and laboratory technician staff)
- The different laboratory tests including names and results
- The different medication prescriptions
- The appointments scheduled

6. Quality Requirements:

5.1 Scalability:

- Patients: Ensure the secure storage and access of patient records for 10 million of patients who will register initially.
- Doctors: Ensure the secure storage and access of doctor records for 1 million of doctors who will register initially.
- Prescription: Ensure that the system is able to record 500.000 prescription at the same time
- Nurse: Ensure the secure storage and access of nurse records for 500 thousand of nurses who will register initially, and 1 million that can access at the same time to the system.
- Admission and discharge: the service should provide admission and discharge services to 200 million of patients per day
- Tests results: Ensure the ability of recording 80 million tests per day

5.2 Performance:

- Account Registration: The system should contribute to high levels of patient satisfaction by streamlining processes, reducing waiting times (no more than 20 seconds)
- Account login: The response time should of the login to system should be no more than 5 seconds
- Account logout: The response time should of the login to system should be no more than 3 seconds
- Check-in. Checking-in a patient into a hospital should be no more than 3 seconds.
- Check-out: Checking-out a patient should be no more than 10 seconds.
- Displaying information and history: Access to patient information or medical, prescription and appointment history should be no more than 5 seconds
- Billing and payment: The response of the system for billing and payment should be no more than 5 seconds
- Order tests: The time system takes to process a test order should not exceed 5 seconds
- Inventory management: editing medication information, amount, price should take no more than 10 seconds
- Staff management: adding, removing, editing staff information should take no more than 10 seconds
- Schedule appointment: the task should take no more than 10 seconds
- Data Entry: The task of entering test result should take no more than 10 seconds
- Instrument troubleshooting: The time elapsed to generate instrument report should not exceed 5 seconds
- Setup hospital account: the task of creating new hospital account should take no more than 30 seconds
- Manage User Accounts: the response time of updating and deleting new accounts should not exceed 15 seconds

5.3 Reliability:

- Cloud Availability. The services provided by the system running on the cloud should

be available 24 hours a day and 7 days a week with a yearly accumulated downtime no more than 10 hours including for planned maintenance and unplanned failures.

- Cloud Meantime to Recovery. The services provided by the system running on the cloud should be able to recover quickly from failures with a mean-time-to-recover less than 1 hour over the period of 1 calendar year.
- Cloud Meantime to Failure. The services provided by the system running on the cloud should not fail frequently with a mean time to failure greater than 1000 hours in a period of one calendar year.
- Mobile Apps Failure Rate. For each mobile App on each platform and for each type of users, the failure rate should be lower than 0.3% per use.