Advanced Online Medical Record System

A Blueprint for Hong Kong Baptist Hospital

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Meeting Avenue: AC1, G5-129

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1. Project Background

1.1 Client Situation

Hong Kong Baptist Hospital is a private hospital in Hong Kong, aims to provide high quality hospital services to the community and manage resources carefully to enhance the efficiency and cost-effectiveness of their hospital utility. However, the traditional medical system shows low efficiency and result in low degree of satisfaction because of the growing need of medical service and the rapid increasing in the amount of medical data. The mission of our client is to improve their medical service and upgrade their medical system by cooperating with us in order to offer a satisfying and efficient hospital environment.

1.2 Problem Definition

In traditional hospitals, record rooms are build to store all categorized medical record in hard copies which are written by doctors and nurses. Also, all appointment making are done by making phone calls or made on person. According to the statistic provided by Hong Kong government, the ratio of healthcare professionals to population is 1: 526 which is much lower than the average level and the number of inpatients increase sharply in the past 5 years as the result of the Aging population.

Since the tradition medical system cannot meet with the need of the increasing demand in medical service, many traditional hospitals have encounter several problems.

1.2.1 Records reservation problem

One of the major problems with the record room is that it is difficult to maintain and records inside can be easily damaged and lost. To maintain a paper-based dataset which contains every medical information needs a lot of manpower, material resources and space resources. To back up a real record room is also very difficult, and so once the record is lost or damaged, it gone permanently.

1.2.2 Medical record accessing

Another problem with the record room is that not only the patient but also medical staffs cannot access the medical records continently and efficiently. To protect the consistency of the record dataset, the hospital need to supervise any action on the medical record including reviewing by patients and updating by medical staffs.

1.3 Client Requirements

To achieve the goal of providing a better medical service to patients, our clients has these requirements on the system:

1.3.1 System Access methods

The system should be able to install in tablet PCs and other handheld devices via the Hospital's Wi-Fi network only.

1.3.2 Data stored

The data stored in the system should include:
- Patients' personal particulars: personal information, medical history, allergy
- Dates of admission into and discharge from the hospital
- All medical records including treatments, check-ups, ward around
- Healthcare staff involved in the treatment

1.3.3 Other requirements

Other requirements include technical support and in particular, system documentation, post-sales training and maintenance service .

1.4 Proposed Solution

To solve the problem of the traditional medical record system**, an online medical record system** is needed in modern hospitals to introduce the method for patients to be clear of their personal clinical data and provide the possibility to doctors, nurses and other healthcare staffs to improve their efficiency in processing any medical record as well as deliver a better service.

To fulfill the requirements from our client, the system will be developed in to a **Web based system and mobile applicatio**n will be developed to enable users to access the system from tablets and mobile devices.

Similar to our previous project e-health, **personnel information data** stored in the system will be **selected** to make it sufficient enough to provide safe medical treatment and not too much to avoid the leakage of personal information. Also, any **details of the medical records** of patients in this hospital will be recorded concurrently with high efficiency

2. System Information

"Hospital content management system" (HCMS) is an innovative and challenge system that would provide an online platform to store hospital information and improve the information accessibility for both medical service provider and patients. On one hand, HCMS provides innovative and practical medical service for patients. On the other hand, it employs cutting-edge techniques for creating a cost-efficiency backend system. The functionality of the HCMS can mainly be separated to two focus: the medical team and patients.

2.1 Functionality for medical team

View and manage patients' personal particular
- Managing the appointments from the patients
- Managing doctors' professional profile
- Creating consultation/medical record for patients
- Viewing and manage admission and discharge record

2.2 Functionality for patients

- Viewing and managing patient medical information
- Making appointment
- Searching doctor information

Apart from the functionality, there are basic hardware requirements for using the services and it will be listed in the following part. For the structure of the backend system, we would like to introduce the “Clustering” technique to handle a large amount of data and the advantages come from this technique.

3. System design

3.1 System function and layout design

3.1.1 Dashboard

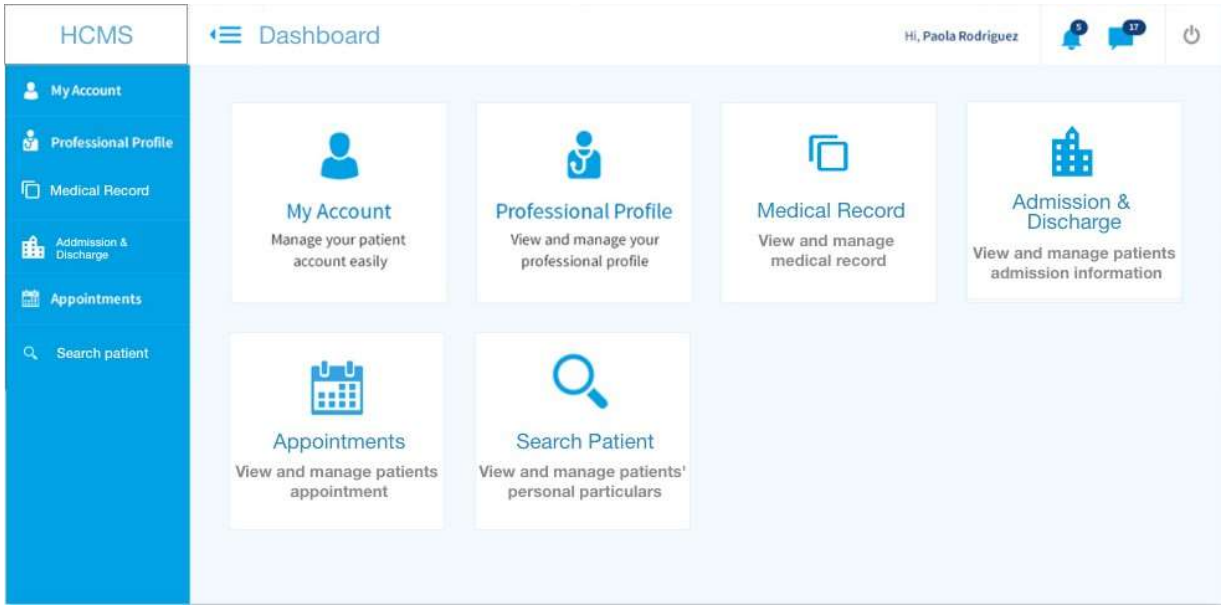


Fig. 3.1 Dashboard for medical team

The dashboard (Fig 3.1) helps medical staffs to navigate to different pages to use the functionality of the system. The system also allows the functionality could be limited by the authorization of the staff account. The patients’ dashboard is similar but only include the function mention above.

3.1.2 Patients' personal particulars

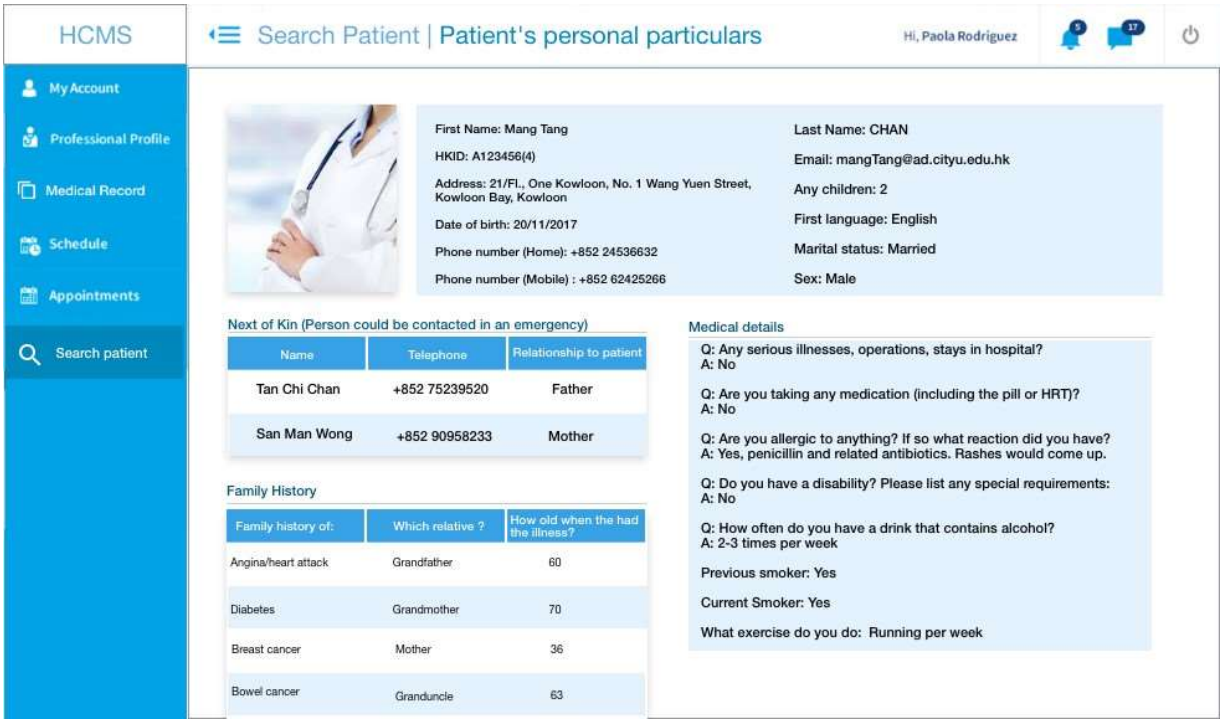


Fig. 3.2 Patient's personal particulars

The patient's personal particulars page (Fig 3.2) could show the pervious stored patient's information which may come from the paper or digital form that filled by the patient. The information in this page includes the patient's background, emergency contacts, medical details and family history.

3.1.2 Professional Profile

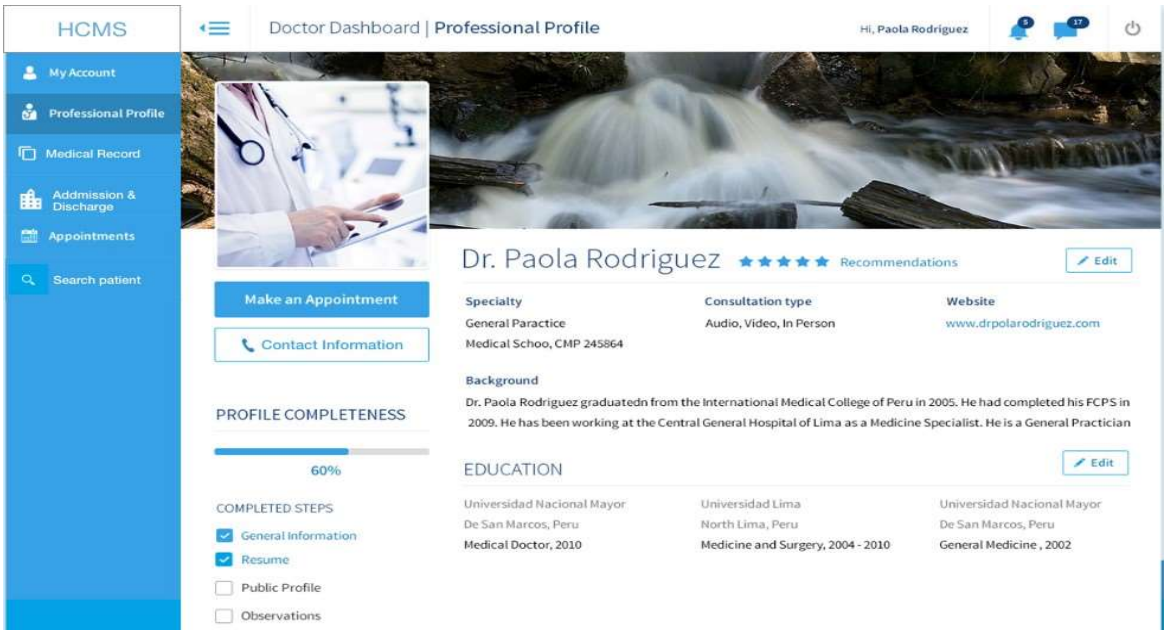


Fig. 3.3 Layout template of the medical team's profile

The professional profile (Fig. 3.3) provides a space for medical staff to fill in their professional information including the background, education, position and contact information. All of the information can either to be set to private or public. The profile is especially important for doctors because the patient may want to understand doctors' background and their specialized field for making suitable appointments. The appointment function for the patient could be disabled according to the staff's situation (e.g. a referral from other doctors is required).

3.1.3 Doctor Appointment

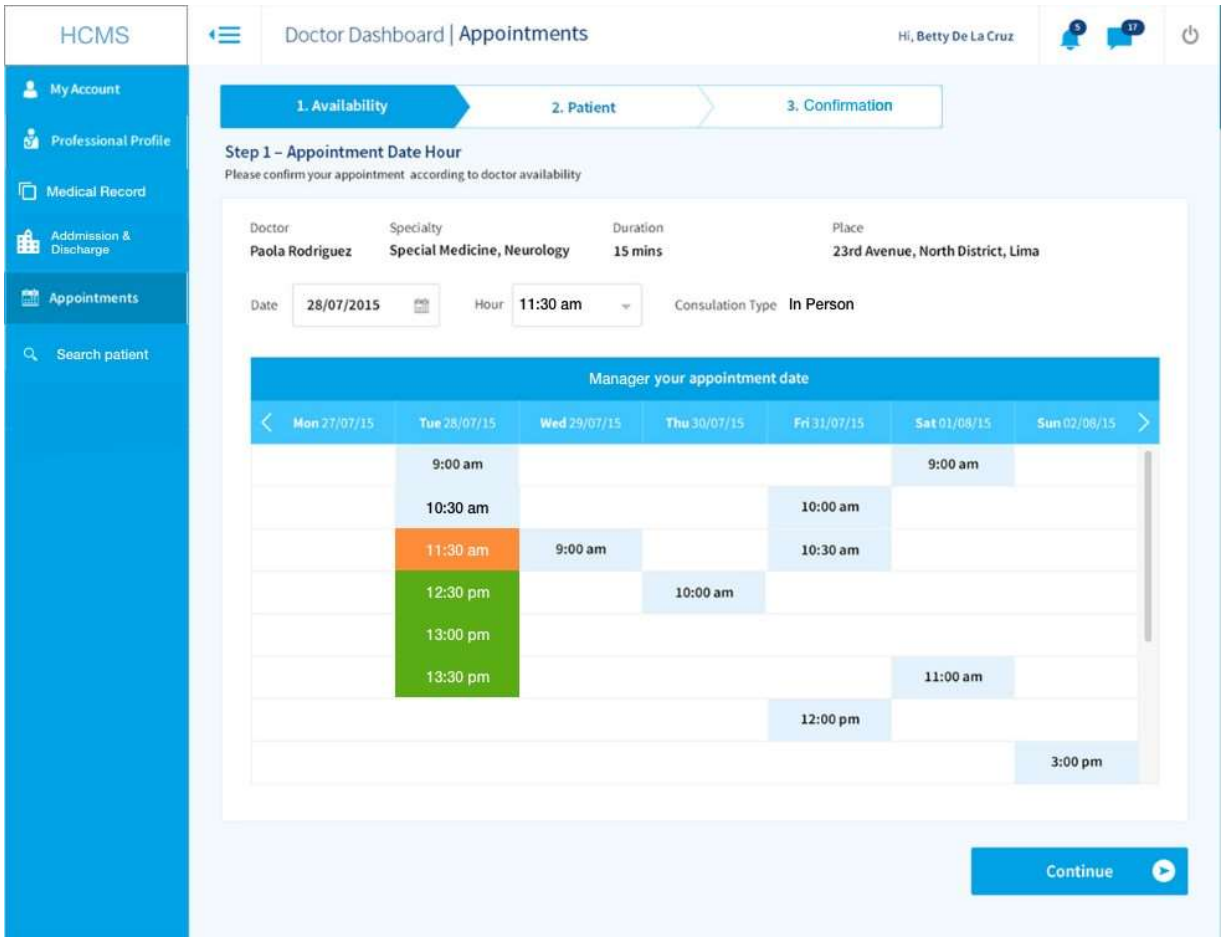


Fig. 3.4a Layout template of doctor appointment management (Availability section)

The appointment page simply shows the grey timeslots which is still available (Fig. 3.4a) and brown timeslots for indicating there are appointment requests from the patients. The staff can follow the step to accept or reject the requests and the timeslot will change to the green colour if the request is accepted, otherwise, it becomes available again with the rejection. After each response to the request, the system will send a notification to the patients through email and Short Message Service (SMS).

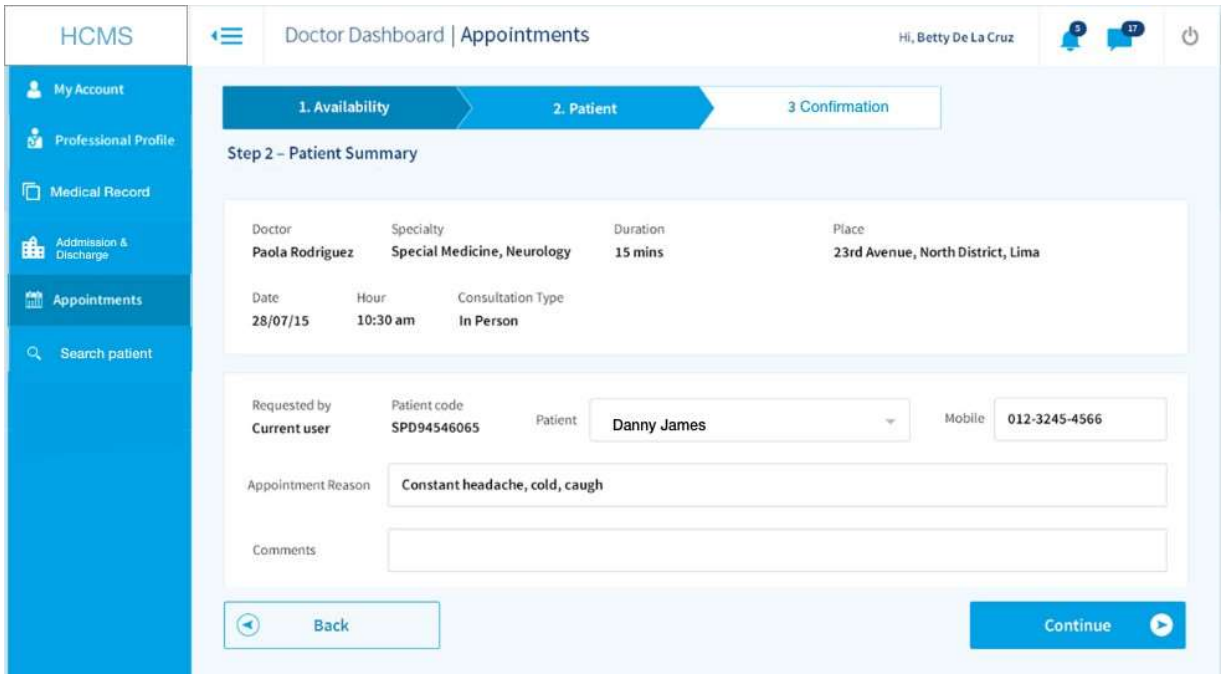


Fig. 3.4b Layout Template of doctor appointment management (Patient section)

Due to multiple requests for the same timeslot, the patient section (Fig. 3.4b) would list multiple patients (staff can use drop to list to switch to different patient) who have requested for the timeslot and the medical staff can only accept one of them and the other will be rejected by the system automatically. The medical staff can choose suitable request based on the appointment reason or the urgency of the requests.

3.1.4 Consultation/Medical Record

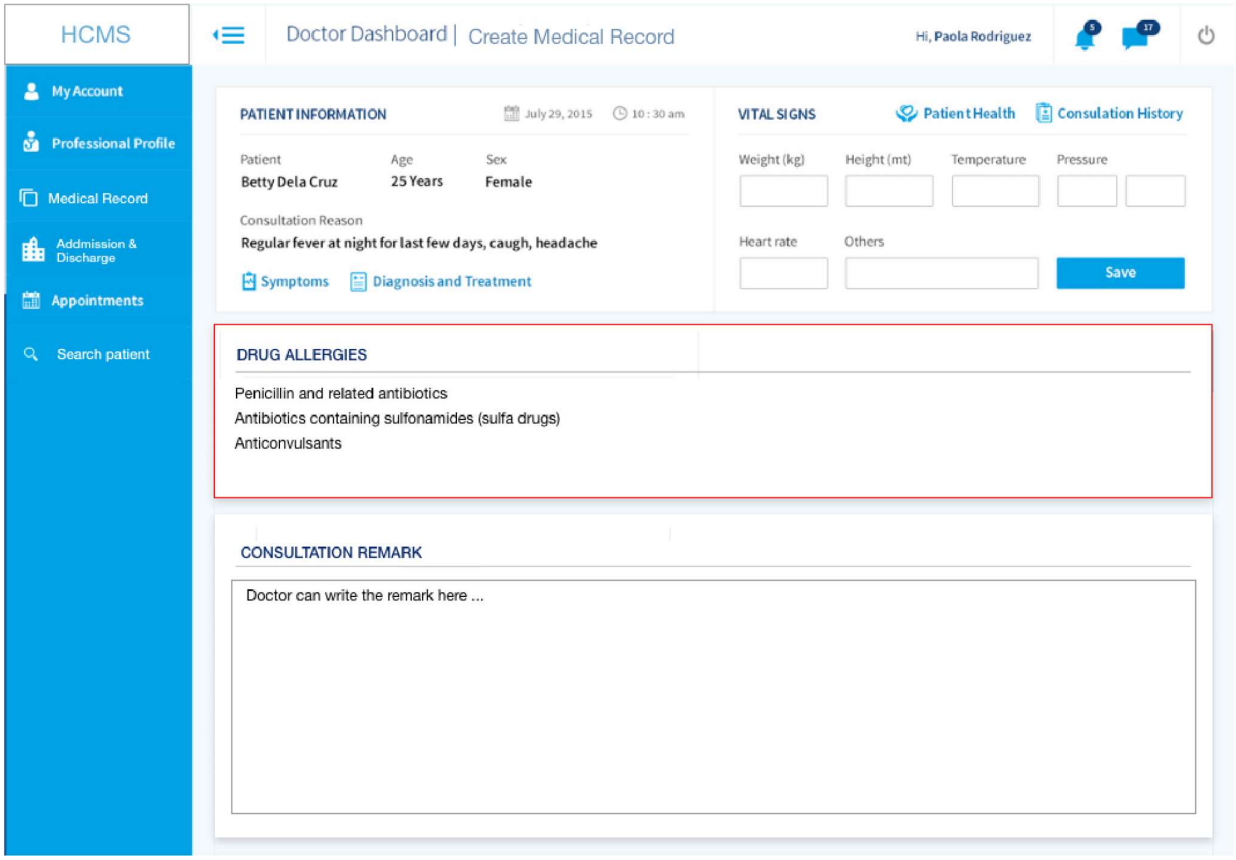


Fig. 3.5a Layout template for creating medical record (upper part)

The medical record page (Fig. 3.5a) shows basic patient's information and the reason for the consultation and the form provide space to mark the vital signs (optional) of the patients. Apart from the basic information, drug allergies symptoms such as skin rash or hives, itching etc. could be a potentially life-threatening reaction. So, the drug allergies information is highlighted with a red border to remind the doctor and avoid to make the mistakes of giving inappropriate drugs to the patients. On the other hand, the doctor can make consultation remark to note down the needs of the patients or any other important information.

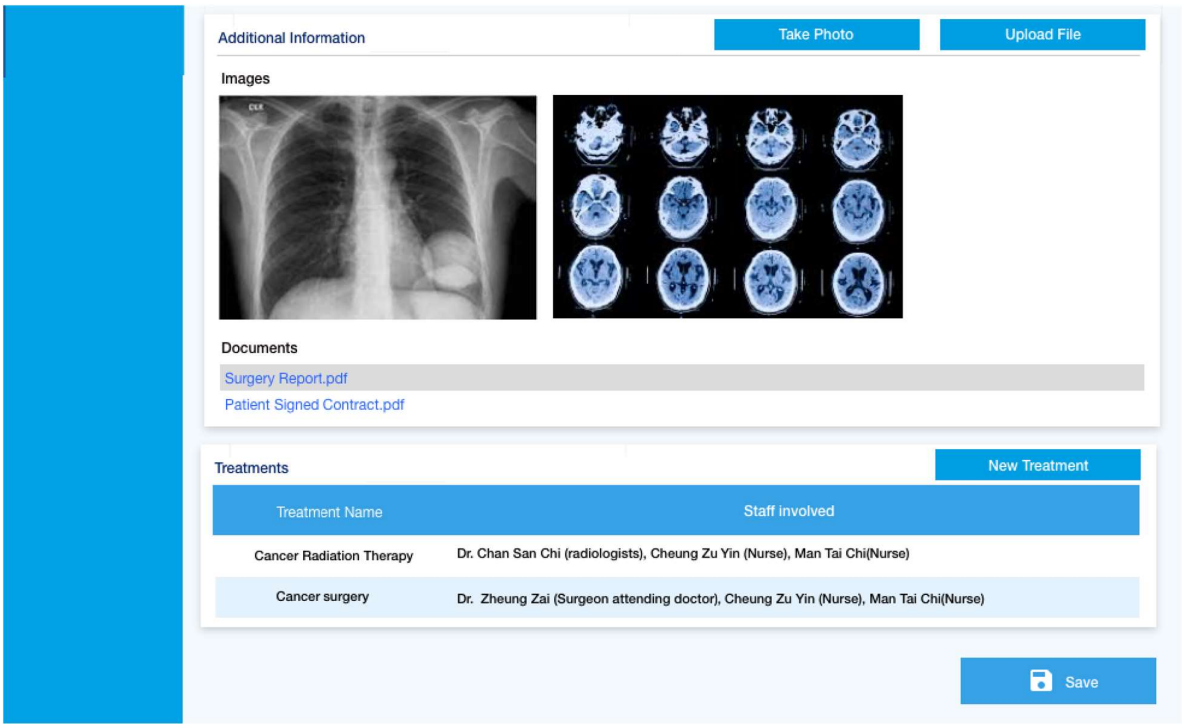


Fig. 3.5b Layout template for creating medical record (lower part)

With uploading files or images, a medical record (see, e.g., Fig.3.5b) integrates all the important information together. For example, the CT scans, PET scans, X-rays images etc. The documents with any format can also be uploaded to the medical record and it would be available for download for the following review. All the medical records would be shown as a list on the medical search page and the doctor can search for the specific record by patient name, date or other information. The treatment information could also be filled in the medical record and each healthcare staff would be listed. After the medical record is created, the patients can view *their own records.*

3.1.5 Admission and discharge

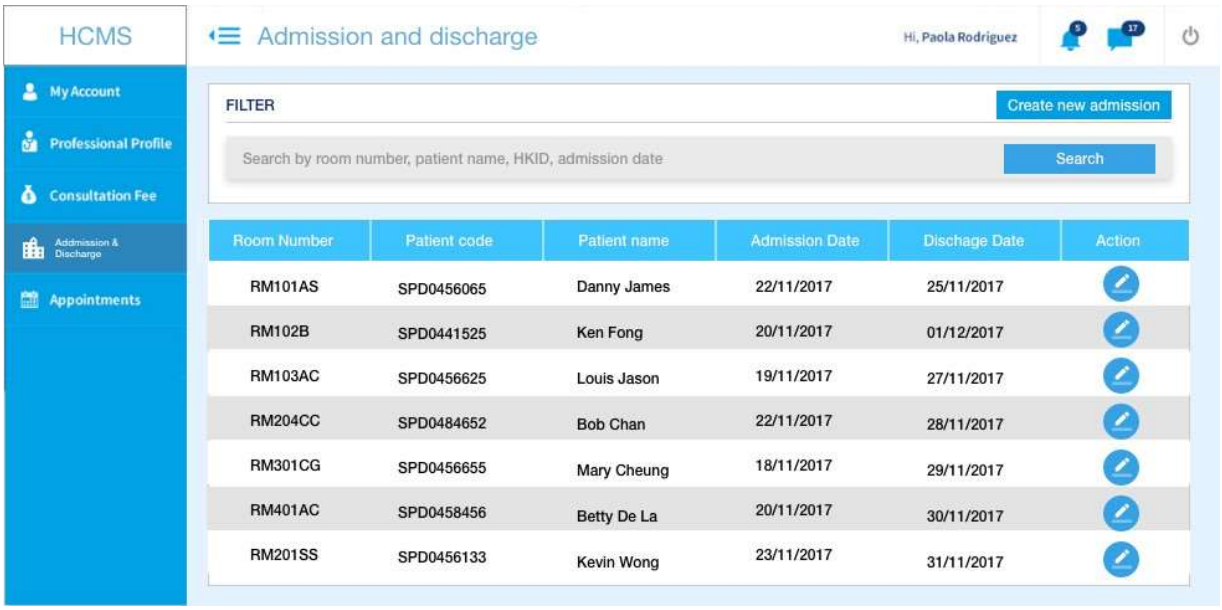


Fig. 3.6 Layout template of room admission and discharge information

The admission and discharge page (Fig. 3.6) can view and manage the status of the room. Medical staffs can search the record by patients' information, the date of admission or discharge and the room number for multiple purposes. Creating and editing record is also available for new admission or extending the duration by edit the discharge date.

3.2 Hardware requirements

The front-end application would be developed on three platforms: website, IOS and Android platform. The following devices could be supported:

- Any Apple devices (iPad, iPhone)
- Android devices with version between Android 4.0 to Android 7.0
- Any personal computers that can support Google Chrome

3.3 Backend server

We would like to use a new technique called "Clustering" to build the server. The main difference between the traditional method and clustering is the amount of the computers. Traditional method usually uses one supercomputer to handle large amounts of user requests. However, clustering use multiple computers to handle the requests and the workload will separate to different computers. By using clustering, we can avoid the expensive cost from the supercomputer and we could expand the scale of the cluster (number of computers) to enhance our performance to handle more requests. As a result, the cost and the performance of clustering are elastic.

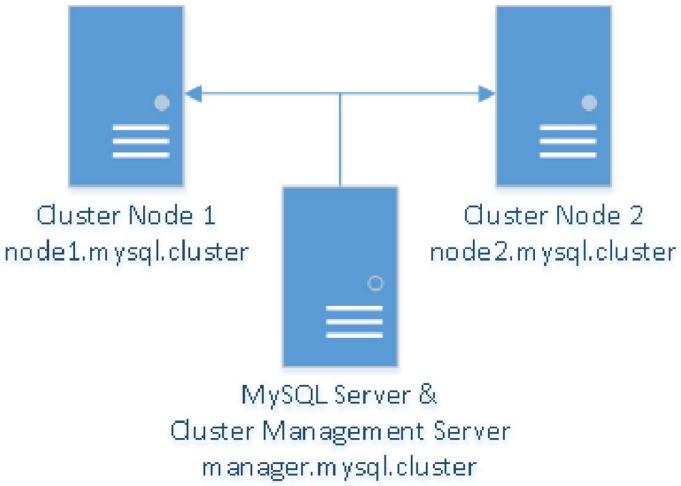
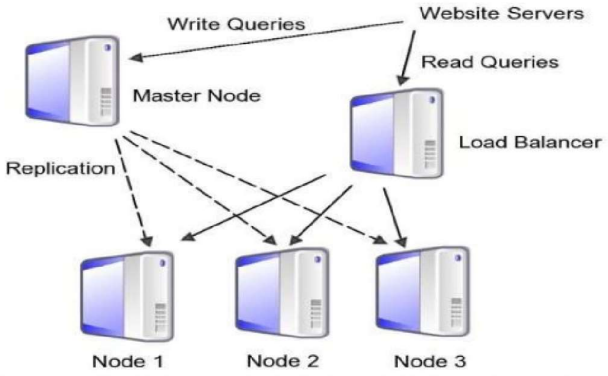


Fig.3.7 Simple MySQL Cluster

We would like to use MySQL Cluster (Fig.3.7) to build up our database system. Each MySQL Cluster would include at least one MySQL Server which is the master of all cluster nodes (other computers). MySQL Server could distribute the works to the nodes and the nodes would get the requested data. However, there are limitations by using cluster and the limitation is that each may need to store the same data. As a result, the cluster would be fault tolerance to handle the nodes crash accidentally because other nodes have the data of the crashed node.



4. Security Measure

4.1 Controlling Access

Users have to register an account for logging in the system and suggested to change passwords every 3 months in order to avoid unauthorized access and provide different levels of data confidentiality.

4.2 System Protection

There will be firewalls to protect the system servers and data from outside attack. The firewalls are programmed to avoid some common network attack: DDoS attack, Brute force

attack and Backdoor attack. Each computer terminals will install anti-virus software before operation of the system in order to avoid system failure caused by virus attack. The software will scan the terminals regularly after working hour and remove suspicious files and software that may contain viruses from the terminals.

4.3 Data Transmission Protection

The servers and user terminals use SSL connection to transmit the web page information. Since SSL connection encrypts the communication between the servers and client terminals, the data transmitted is protected and cannot be read or modified by attackers.

4.4 System Backup and Recovery

The system backups to a server separated to the system network after working hour every weekend. The information cannot be access during backup and suspend the normal operations of the system. Backups can keep the system reliability since the backup server is not affect by the operations of the system that the system data can be recovered when there is a system failure or data lost by recovering the backup of the day before from the backup server.

4.5 System Maintenance

The system and its component will be audited their functions operate accurately every 3 months automatically and generate audit reports. System administrators should check the audit reports if there are any functions work abnormally and solve the problem with the system maintenance guide. When the problem is not included in the guide, administrators should contact our technical support team.

5. Testing Launching

After the system installation, there will be a period of launching test which last for 20 days. Our technical support team will test the operation of the system in site and handover the data and work from the old system to the new system. In this period, both the old system and the new record system will operate together since the new system may occur problem operating in site. We will solve the problems occur and update the system in this period. After the testing period, the new system will start the normal operation and the old system will be disabled.

6. Cost and deliverables

6.1 Cost

6.1.1 Setup of the Health Record System

Below shows the breakdown of the cost and details of each item.

Item	Cost (HKD)
a) Central Database (Data Centre)	300,000
b) Server	100,000
c) Computer Hardware Update	400,000
d) Operating SystemUpgrade	200,000
e) Software system development	400,000
f) Network erection	50,000
g) Mobile app development	200,000
Total:	1,550,000

a. Central Database (Data Centre)

Refer to the table, as regards section (a), the estimated budget of 300'000 Hong Kong dollars is for the procurement of Hard disk groups, which is used for saving all health records.

b. Server

While the 100'000 Hong Kong dollars in section(b) is for computers, which will handle all the backend processing task.

c & d Computer Hardware Update &Operating System Upgrade

Per our last meeting, the existing computer system in our hospital is incompatible with our Electronic Health Record System, in that case, we will do the system upgrade work. The cost in section (c) and (d) is for the procurement of new computers and accessories, license of new Windows Operating System and end-user software.

e. Software system development

As regards section (e), the total price 400'000 includes the development and installation fee of our software system for clinicians. Which the development process will cost $300,000, and the installation fee is $100,000.

f. Network erection

As regards section (f), $50,000 includes the equipment and installation cost.

g. Mobile app development

$100,000 will be needed to develop the end-user mobile application for patients to check medical records. The operating mechanism of mobile app is different with PC software, which is developed by an independent team.

6.1.2 Maintenance

Below is a breakdown of the items included in maintenance.

Item	Cost(HKD)
a. Training	100,000
b. Hardwaremaintenance	100,000
c. Software Upgrade	100’000
d. Professional support service	100’000
e. Annual Check	50,000
Total:	450,000

The total cost shown above is for 1-year all-round technical support. The aggregate budget of our system is about **1,950,000** Hong Kong dollars.

6.2 After Sales Service

1-year Warranty

Clients may earn a year of warranty from the date since the whole system has setup correctly. They can claim for any defects at any time, including weekends and public holidays. The 1-year warranty will not be suspended unless the system is artificially damaged, or involved in illegal use (violation of license agreement), in that case, customer may need to pay a certain amount of material fee. Before the warranty is ended, customer can extend their system warranty and support service contract with a preferential price.

Training Scheme

We will provide a 7-days training scheme for every clinician who will use our system, which the training scheme will be Cantonese in order to insure all doctors can understand. And to minimize the impact on operation of the hospital, the training scheme can be provided in batches if needed.

Customer Service

During the warranty period, we provide Hardware maintenance and Software Upgrade service to insure the operation of the system is stable. We will assign technicians set up a counter in our hospital helping teach patients how to use mobile phones or computers checking his/her medical record and to register consultation. Our free customer service hotline is available in 7x24 hours, we are willing to answer questions at any time.

Annual Check

We will conduct an annual check after a year the system is come into use. The annual check

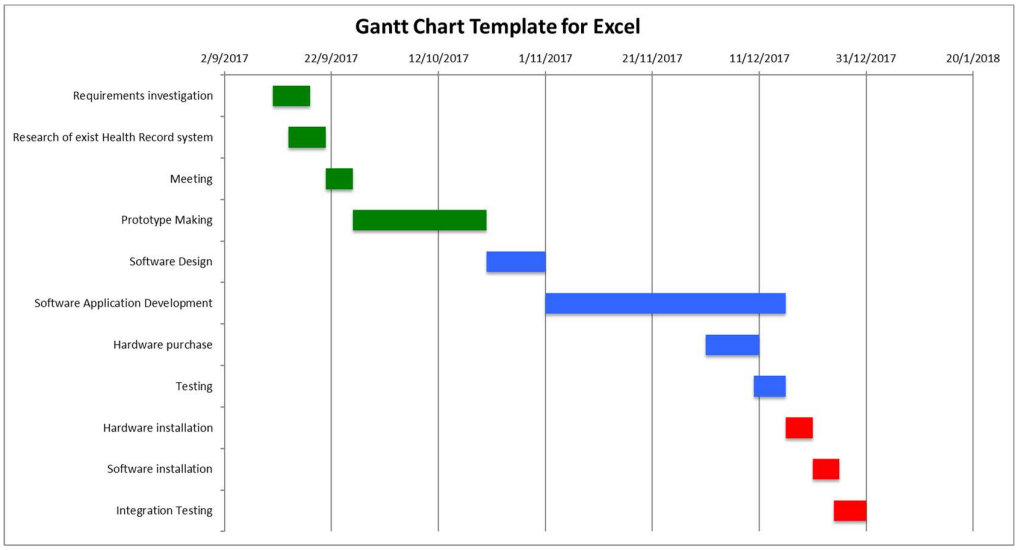
contains a comprehensive inspection of the whole system, including central database, server, computer hardware and software, and a survey to clinicians and patients. We will generate a usage report and make improvements if there is any.

7. Project duration and stages

7.1 Project Duration Table

Stages	Duration (Days)
Preparatory Stage	
Requirements investigation	7
Research of exist Health Record system	7
Meeting	5
Prototype Making	20
Project Development Stage	
Software Design	10
Software Application Development	45
Hardware purchase	10
Testing	10
Product deployment Stage	
Hardware installation	5
Software installation	5
Integration Testing	7

7.2 Project Timeline



8. About us

8.1 Company Background

Since 1995, ROSS Tech has been delivering full C software development services to customers in over 30 countries worldwide. ROSS Tech is an expert in development, customization and integration of complex enterprise-level solutions, advanced web and mobile applications offering a well-balanced blend of technology skills, domain knowledge, hands-on experience, effective methodology and passion for IT. As of 2016, ROSS Tech is the world's top 10 largest software maker by revenue, and one of the world's most valuable companies.

8.2 Our Aims

We strive to provide our clients with the best solutions to your business system needs. We place great emphasis and focus on their problems and develop solutions that best fits their needs. We offer strong and effective solutions to their business with an enduring impact. We think of ourselves as our clients' long-term partner. By supplying our customers with top resources and skills, we fulfill our main goal - add value to their businesses through knowledgeable application of information technologies

8.3 Our Experience

Our best known software products are the ROSS operating systems, the Ctrip travel booking application, and **the e-heath electronic medical record system**. The e-health electronic medical record system is a government project aims to provided patients with convenient access to their personal medical records. According to a feedback survey, more than 70% Patients form public hospitals that involved in this project experienced a better service by using the e-health system.