

IMPLEMENTATION OF HOSPITAL MANAGEMENT SYSTEM IN RURAL SPACES AS A CASE STUDY USING OPEN SOURCE EMR BAHMNI

A Major Project

Report

Submitted in partial fulfillment of the requirements for
the award of the degree of

**Bachelor of Technology
in
COMPUTER SCIENCE AND ENGINEERING**

By

S.V.N. PRIYANKA (14003214)

B. ASHA JYOTHI (14003389)

J. LIKHITHA (14003572)

Under the supervision of

K. SRIPATH ROY

Assistant Professor



KONERU LAKSHMAIAH EDUCATIONAL FOUNDATION

Green Fields, Vaddeswaram, Guntur(Dist)- 522502

Andhra Pradesh, India.

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING



Declaration

The Project Report entitled “**IMPLEMENTATION OF HOSPITAL MANAGEMENT SYSTEMS IN RURAL SPACES AS A CASE STUDY USING OPEN SOURCE EMR BAHMNI**” is a record of bonafide work of S.V.N.Priyanka(14003214), B.Asha Jyothi(14003389), J.Likhitha(14003672) submitted in partial fulfillment for the award of B.Tech in “Computer Science and Engineering” to K L Deemed to be a University. The results embodied in this report have not been copied from any other department/University/Institute.

S.V.N. PRIYANKA	(14003214)
B. ASHA JYOTHI	(14003389)
J. LIKHITHA	(14003672)

KONERU LAKSHMAIAH EDUCATIONAL FOUNDATION

Green Fields, Vaddeswaram

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING



Certificate

This is to certify that the Project Report entitled “**IMPLEMENTATION OF HOSPITAL MANAGEMENT SYSTEMS IN RURAL SPACES AS A CASE STUDY USING OPEN SOURCE EMR BAHMNI**” is being submitted by S.V.N.Priyanka(14003214), B.Asha Jyothi(14003389), J.Likhitha(14003572) submitted in partial fulfillment for the award of B.Tech in Computer Science and Engineering to K L Deemed to be a University is a record of bonafide work carried out under our guidance and supervision.

The results embodied in this report have not been copied from any other department/University/Institute.

Signature of the Supervisor

K. Sripath Roy
Asst.Professor, ECE

Signature of the HOD

Hari Kiran Vege
Head of Department, CSE

Signature of the External Evaluator

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S.V.N. PRIYANKA	(14003214)
B. ASHA JYOTHI	(14003389)
J. LIKHITHA	(14003672)

ABSTRACT

Hospital Management system aids to keep the patient diagnosis details and mapping those diagnosis details to doctors. These records help in future use. Majority of Hospitals already implemented this System. But, the problem is they are not interconnected in such a way that the patient record of one hospital is not disclosed to the other, which is a burden on the patient to carry all the records and undergo all the diagnosis again. This also adds to the problem for remote health care monitoring, where a doctor can remotely access the patients records and suggest the remedy. We implemented a case study to interconnect the Public Health Care (PHC) centers in rural spaces using the hospital management system. Bahmni as an open source EMR is used to implement to aid this system. Data Management is the main reason that a hospital needs IT-based support.

Keywords: Hospital Management, Open Source, Bahmni, Patient Monitoring Records.

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CHAPTER 1

INTRODUCTION

1.1 HOSPITAL MANAGEMENT SYSTEM

Hospital Management System means integrating all the operations done in hospitals through traditional approaches encompass paper works information such as patient registrations, patient details storage, medical facilities, financial, legal, administrative operations and compliance. As technology is growing faster rapid changes are done in every sector. In order to overcome the problems which are faced by the patients and staff, we can change some of the hospital offline operations into online by developing the software. Making the complex operations into the simplest way reduces stress. Hospital Management systems are in high demand to handle increasing population needs.

A well-implemented Hospital Information system means readily available patient data to the care providers. All the requisite information about a patient, from various departments in the hospital, can be available on the screen. Logging into the HIS will give the instant access to those reports and timely treatment decisions ensure. There are various metrics available to assess the performance of services, and the successful implementation and usage of Hospital information system performs a crucial role.

In modern information times, knowledge updates continuously and fast. People need a fast, exact and efficient method to acquire and process information. For solving this we make use of Hospital Information Systems. When there is a bulk incoming of patients increases then it is difficult to manage them and correct scheduling of doctors for their checkup may make difficult for the staff. Even though we may think to manage, but it is difficult to store the patient details in the paper based flat files. So in order to reduce the laborious work we have to follow the technology. Now-a-days Engineering Technologies are making vast inventions in every real life problems. For solving this we make use of Hospital Management Systems. This makes working the staff smart and efficient way. But the staff should have basic knowledge about the computer usage and should be pre-trained about the software and the usage of it. Encouraging the technology makes the engineers to implement

still more efficient ways for the situations where humans are brainstorming to solve the problems.

The software designed for Hospital Management System is to manage all the aspects of functional operations which are held in Hospitals. This is one of the idea to integrate the health care solution which solves the problems like Inpatient and Outpatient Management, Radiology, Clinical, Appointment scheduling, Laboratory facilities, Patient Facility Management, Pharmacy, Ward Management, Accounting and Electronic Billing. This makes the provider also easy to check the previous medical services which are provided to the patients and providing new medical services based on the patient's condition. This software also provides another technology by sending an alert message or email if the patient checkup status is in pending, if the patient registered online then the appointment status and other information. This improves the quality of patient care. This is the most effective way of storing the patient records.

Electronic Medical record (EMR Systems) knows about revenue streams, patient records and other key measurements readily available. Storing and retrieving the patient information in the cloud is very easy in now-a-days by using the technological computer systems. This makes the patients, providers and staff easy to check the reports online. Our EHR Software permits electronic sharing of patient records with different doctors and medical applications and manage the health of patients, for example, Patient and Providers can see lab results and history on the web.

The way now we are using the Hospital Management Systems are not interconnected. Lack of rural support and the infrastructure it is not possible to implement the interconnected hospital management systems in many hospitals. So, Bahmni as an alternative software for developing the Hospital Management System.

1.1.1 Software helps in rural areas

Now-a-days majority of the public Hospitals follow the Hospital Management System. But, the problem with it is they are not interconnected. For example, if a person goes to hospital for checkup in his local place. When he migrates to another place and again, he needs to continue his medication for that what course he used is not known to the doctor when he visits the new providers. So in this case if the data are interconnected, then it is easy to maintain the records and easy to the doctors to

further proceed. Bahmni is an alternative software for implementing the interconnected Hospital Management System.

Implementing bahmni in rural space with very less infrastructure as a server which provides basic patient, doctor data.

Many hospitals in rural areas cannot afford to buy the commercial software to help with the hospital management. So, this Bhamini software was created to serve their needs. The software can help the process of registration, evaluation, physical exam, prescription, investigation, dispensing and billing plus health promotion and health prevention to transform hospital services to paperless process and meaningful data flow.

To improve quality, safety and efficiency in the healthcare services, bhamini is considered as the most competent and optimistic tool.

The Poor Rural Communities Development Project seeks to improve livelihood security, and achieve a sustained participation of the rural poor in project design, implementation, and in the monitoring and evaluation aspects within the three project provinces.

Utilization of Bhamini in India is very less though it is our pride that India is the hub of IT and IT enabled services industry. Presently bhamini is being used for different purposes in the healthcare service in India like telemedicine, digital, medical library, hospital management systems, electronic health records, etc. Bhamini can not only automate the full medical procedure electronically but it can very effectively avoid duplication of various costly tests, reduce costs and also modernize medical care. For instance, cancer treatment needs a long period of time over years and to track back the patient's previous records it becomes very tough for the medical institutions. But now all the medical images and patients' records can be stored electronically and at the time of need one can always refer back to the old one.

Though big corporate hospitals, private healthcare sectors and big pharmaceutical companies are using this technology very efficiently but the public healthcare sector is far behind. There can be an immense usage and contribution by the hospital management system as most of the hospitals especially the public hospitals still now maintain all the information manually as they generally avoid using IT. Presently

there are innumerable software applications available in the market which are capable enough to maintain the required information properly and can help healthcare services to face the major challenges of healthcare delivery.

By the help of electronic health record (EHR), every health information about individual patients can be collected electronically and systematically which digitally record all information that can be shared with other healthcare bodies.

In the digital medical library all the information are stored which can be accessed by the computers that help the medical practitioners and all the people who are associated with this profession to improve healthcare services in our country. Medical libraries which are found in hospitals, different clinics and medical schools can be accessed at any point of time from any place and needs very little storage place.

E-learning technology has a great potential in the healthcare services, by which skills and knowledge can be transferred electronically in the form of audio, video, text and other formats that can be conveyed by any medium like internet or intranet, satellite TV, CD-ROM, etc.

1.2 IMPORTANCE OF HMS

Performance Metrics

Most of the medical management system vendors claim to increase the productivity of clinics and hospitals, but very few manage to address the simpler day-to-day tasks and often end up making things far more sophisticated for the users of such hospital software systems than they really are. Therefore, in order to highlight the importance of an ideal doctors management system software, we have compiled a list of the performance metrics which define the effectiveness and efficiency of such hospital software systems.

1.2.1 Streamlining of Patient's Appointments & Scheduling Process

The clinical software must be adept in simplifying the complex appointment scheduling process of patients so that the ordeal of the patients waiting endlessly for their turn can be eliminated. Also, it would enable the doctors to reduce their dependence on staff regarding such issues.

1.2.2 Electronic Medical Report Generation

The medical record software must be able to generate the electronic medical records for the convenience of the doctors and clinic management. This helps in keeping a tab on the medical history of patients which can be retrieved any time in the future. Additionally, it relieves the clinic and hospital administrators from the maintenance of paper documents and registers for such purpose.

1.2.3 Processing Patients Claims through Medical Billing Software

One of the most critical tasks performed by the Medical billing software is the processing of patients claims of medical insurance, payments and other reimbursements. With the help of such clinic billing software, this process can be seamlessly managed as you would be having all the required data & information at your disposal at just the click of a button.

1.2.4 Timely Automated Reminders to Patients for Vaccination

The medical management system must have the in-built mechanism to be able to send automatic alerts to the patients reminding them about the impending vaccination. It enables the patients to avoid unnecessary visits to the clinics thereby enhancing the overall patient experience.

1.2.5 Proper Management of Drug Inventory

It is highly important to keep track of the stock of drugs available with the clinic or hospital. This helps the medical offices to replenish the out of stock drugs in a timely manner. But most importantly, the doctors management system software also sends regular alerts when a particular drug nears its expiry date. This facilitates the doctors and clinic administrators to discard them at the right time thereby making way for the fresh stock.

All these aforementioned metrics are crucial to the clinics and hospitals not just to provide quality healthcare to patients but also to improve the productivity of the medical offices.

With online applications, data could be managed and controlled centrally. The better organization, brought together control on rates of the organization, pay roll organization, appointment management, better resource administration, and use, are a couple of things which could be accomplished with the offline software model of HMS. Sometimes it is called as **billing software**. Alongside that, the review trial highlight guarantees a history log of

changes done to any information. We had colossal criticism on this article: Why center programming is an absolute necessity for facilities.

Does your present software application give control over the client access to specific data? With front line customer organization elements and get to controls, there is an upgraded data security and ceaseless accessibility of data. To be sure, the information reinforcements over the centralized database are a wide feature of these software.

1.3 Advantages of Hospital Software

Health care is a crucial service that needs dealing with lot of documents, papers, forms etc. Healthcare as an industry is rapidly growing, the volume and cost of document management are steadily increasing. Not only it requires an efficient and proper hospital information system but is also crucial for the daily operation.

In most of the nursing homes, hospitals and healthcare institutions are highly regulated regarding documentation and management. Hospital management software is a tool that manages all of administrative, management as well as marketing of a hospital to allow them and doctors to serve better. Following are the major advantages of hospital software in today's healthcare industry.

1. **Marketing and Sales:** A hospital needs an efficient hospital management system that will track its marketing and sales Resources and Information performance. It is designed as a comprehensive system to track all leads generated from all sources and deliver it on a consolidated platform.
2. **Accounting and Administrative:** The purpose of hospital software is that tracking of accounts and the financial transaction matters. It helps hospitals maintaining of the clarity and facilitates. It functions as a central repository of the patient's records offering data on a infinite platform and thus helping hospitals in lasting a long time by data security and confidentiality rules set by authorities.

Hospital management software can fundamentally the way different hospitals and clinics are communicating healthcare services. In the current scenario of healthcare sector, patients are not quite happy with the service they are being offered. Manual prescriptions which contains lot of errors, doctor's appointment are not on a particular time, unorganized schedule of medical field are some of the major challenges for this

type of sectors. There is an urgent need to take some valid tasks of healthcare system, and hospital management software can play a vital role in this sector.

Reasons to upgrade the HMS

Hospital management system software works towards making processes organized and productive by managing every aspect of hospital administration. By taking help of technology for managing hospital administration, a healthcare unit can focus more towards providing real-time treatment to patients.

Listed below are some of the reasons why any modern hospital or clinic should upgrade to Hospital management system software.

1.3.1 Increased Patient Satisfaction

By offering user-friendly patient portals and mobile-based applications, hospitals and clinics can enjoy increased patient participation. Patients can check a doctor's schedule online, book appointment, and access their electronic medical records online. This can save a patient's time and energy, as they no longer need to stand in a queue for an appointment or manual prescriptions. Patients can develop trust over hospitals and its services.

1.3.2 Better Control Over Hospital Administration:

To manage the appointments of daily schedules for doctors, creating a special record of patient's medicines and treatment history of each patient, managing medicines for each check up, tracking the availability of beds for each patient, managing payment and transactions are some of the major tasks of a hospital that need to be done on a daily basis. For the error-free management of these administrative processes, hospitals need to take the help of a hospital management software. Hospital Management System software works by administrative processes, so that there is no chance of error. It also saves time and effort of hospital management system, so that they can be focus more upon offering the solutions for requirements of patients.

1.3.3 Secured Data Backup

The hospital management software applications helps data transfer of hospital administration. Patient details are considered to be confidential and it is even more important to create an electronic medical records. These records are accessed only whose has login credentials, and there is no chance for any breach. And also, the backup of data is created over cloud to prevent data loss or damage. The cloud-based data can be accessed only by authorized users through mobile devices, saving their time in searching them manually.

1.3.4 Better Revenue Management

It requires a large amount of money to run a hospital, so revenue management is as important as providing the best service to patients. The healthcare sector is becoming more profitable, relying on age-old manual systems for tracking inflow and outflow of finances is not a viable solution. Hospital management system software in India are designed to meet the business requirements more efficiently and accurately. By automated hospital management system software, hospitals can enjoy fast and accurate transactions easily. Hospital Management System software can generate different transactional reports quickly to help the management system in figuring out the scope of income and areas of expenditure very easily.

1.3.5 Improved Hospital Reputation

In present generation, people trust only on computerized systems not on manual efforts. A healthcare setup that uses a hospital management system for managing its administrative tasks is likely to have an image of a tech-savvy and modern unit. The HMS software also helps in creating a higher level of trust on a medical setup with good online reputation among patients. In the present competitive scenario, the reputation management is equally important and hospitals can easily rely on a HMS software for it.

Overall, HMS software tools help in creating a collaborative environment between doctors, hospital staffs and patients to ensure a commendable service at every stage.

Hospital Management Software is a tailor-made solution for all administrative requirements of hospitals, clinics, and other healthcare units. It helps in tracking doctor availability and schedule, patient appointment, medical records, pharmacy availability, inpatient and outpatient details, etc. Also, the availability of beds can be

tracked and doctor charges can be compared with the help of different hospital management software solutions.

The benefits of hospital management software :-

- Timely reminders to patients for vaccination
- Proper management of drug inventory
- Processing Patients claims through Medical Billing Software
- Efficiency from patients admission to discharge process
- Higher departmental collection
- Laboratory efficiency
- Easy access to doctors data to generate varied records, including classification based on demographic, gender, age, and so on. It is especially beneficial at ambulatory (out-patient) point, hence enhancing continuity of care. As well as, Internet-based access improves the ability to remotely access such data.
- It helps as a decision support system for the hospital authorities for developing comprehensive health care policies.
- Efficient and accurate administration of finance, diet of patient, engineering, and distribution of medical aid. It helps to view a broad picture of hospital growth
- Improved monitoring of drug usage, and study of effectiveness. This leads to the reduction of adverse drug interactions while promoting more appropriate pharmaceutical utilization.
- Enhances information integrity, reduces transcription errors, and reduces duplication of information entries.
- Hospital software is easy to use and eliminates error caused by handwriting. New technology computer systems give perfect performance to pull up information from server or cloud servers.

Here I list few benefits of Hospital management software,

- System Implementation on time, within budget and to the right quality.
- Expert Support 24 * 7.
- Supporting large and critical applications.

- Reduced over 70% of the paper cost and saved the revenue.
- Comprehensive User Security

Heightens Patient Care

In a word, it sets a standard for patient care, making it more constant and reliable. Information kiosks put up at leading health care facilities make use of this system. These kiosks serve as an information source for patients and their family members by helping them to know more about their illnesses and conditions as well as the treatments available.

Increases Cost Control

Another advantage of having **Hospital Management Software** is that it plays a crucial role in cost control by enhancing productivity and efficiency. Inventory and personnel costs are minimized through the avoidance of repetitions and duplications. The software can also help reduce delays and confusion, which are caused by missing or incomplete records. This application can also be looked upon as a management tool, which offers the functionality of amassing different kinds of data into usable reports.

Boosts Data Security

As far as the security of the patient and protection of administrative information is concerned, *hospital management software* offers unparalleled performance. With its security modules, department-specific information can be accessed and guarded as and where needed.

Hospital management system is essential for all healthcare establishments, be it hospitals and nursing homes, health clinics, rehabilitation centres, caregiver facilities or doctors' chambers, outpatient clinics, dispensaries, independent pathology laboratories etc. The installation of this software results in improvement in

administrative functions and hence better patient care, which is the prime focus of any healthcare outfit.

1.4 FOSS

Free and open-source software (FOSS) is computer software that can be classified as both free software and open-source software. That is, anyone is freely licensed to use, copy, study, and change the software in any way, and the source code is openly shared so that people are encouraged to voluntarily improve the design of the software. This is in contrast to proprietary software, where the software is under restrictive copyright and the source code is usually hidden from the users. The benefits of using FOSS can include decreasing software costs, increasing security and stability (especially in regard to malware), protecting privacy, and giving users more control over their own hardware.

1.4.1 ADVANTAGES OF OPEN SOURCE SOFTWARE

What is Open Source?

Open-source software is software whose source code is published and made available to the public, enabling anyone to copy, modify and redistribute the source code without paying royalties or fees. Open source code evolves through community cooperation and collaboration. These communities are composed of individual programmers as well as very large companies. Rather than proprietary companies wasting resources on building redundant software, open source communities and companies collaborate their resources to build software much more efficiently. It has been reported that open-source software has resulted in at least \$60 billion dollars in savings to consumers.

Why use an Open Source EHR?

If Open Source software has resulted in \$60 billion dollars in savings to consumers, then isn't it about time the healthcare sector also started to benefit from Open Source software?

Just imagine the following:

1. You have access to free, feature-rich EHR software.
2. You have complete control over this EHR software.
3. You have complete control over your patient's data.
4. You can hire (and fire) whomever you want to support your EHR software.

An Open Source EHR provides all of these things!!!

OpenEMR provides all of these things!!!

Because the nature of open source software means that you can actually look at and change the software code yourself, several fundamental changes occur that are beyond the control of your software vendor and you as an end user are in control. It will be a rare administrator or physician that will choose to modify the code themselves, but this means anyone with the skills can do so and you are free to hire your own personnel or contract with an independent company to make these changes. Normally software is encrypted and hidden from the end user. You are forced into signing an End User Licensing Agreement (EULA) which basically means that you don't own the software, you are just leasing the right to use the software. The license then includes a number of bad scenarios where you lose the right to use the software and have to immediately give back the software including all copies of the software.

Today open source software has become critical for almost every organization. Almost everything requires open source software, be it telecommunication systems, inventory, accounting, personal productivity applications, contact management and operating systems amongst others. At Outsource2india, we have experienced and skilled software engineers who can proficiently build a software system by using open source software. With our expertise in java development, we can also develop application blocks. We also use our system integration services to make sure that the new application that we create can be easily integrated with your existing systems. Outsource open source software development to O2I and benefit from high-quality services at a cost-effective price.

Open source software can have a major impact on your entire organization. There are several advantages of using open source software. The following are a list of the advantages of opting for open source software.

1. Lesser hardware costs

Since Linux and open source solutions are easily portable and compressed, it takes lesser hardware power to carry out the same tasks when compared to the hardware power it takes on servers, such as, Solaris, Windows or workstations. With this less hardware power advantage, you can even use cheaper or older hardware and still get the desired results.

2. High-quality software

Open source software is mostly high-quality software. When you use the open source software, the source code is available. Most open source software are well-designed. Open source software can also be efficiently used in coding. These reasons make open source software an ideal choice for organizations.

3. No vendor lock-in

IT managers in organizations face constant frustration when dealing with vendor lock-ins'. Lack of portability, expensive license fees and inability to customize software are some of the other disadvantages. Using open source software gives you more freedom and you can effectively address all these disadvantages.

4. Integrated management

By using open source software, you can benefit from integrated management. Open source software uses technologies, such as, common information model (CIM) and web based enterprise management (WBEM). These high-end technologies enable you to integrate and combine server, application, service and workstation management. This integration would result in efficient administration.

5. Simple license management

When you use open source software, you would no longer need to worry about licenses. Open source software enables you to install it several times and also use it from any location. You will be free from monitoring, tracking or counting license compliance.

6. Lower software costs

Using open source software can help you minimize your expenses. You can save on licensing fees and maintenance fees. The only expenses that you would encounter would be expenditure for documentation, media and support.

7. Abundant support

You will get ample support when you use open source software. Open source support is mostly freely available and can be easily accessed through online communities. There are also many software companies that provide free online help and also varied levels of paid support. Most organization who create open source software solutions also provide maintenance and support.

8. Scaling and consolidating

Linux and open source software can be easily scaled. With varied options for clustering, load balancing and open source applications, such as email and database, you can enable your organization to either scale up and achieve higher growth or consolidate and achieve more with less.

Any disadvantages?

Because there is no requirement to create a commercial product that will sell and generate money, open source software can tend to evolve more in line with developers' wishes than the needs of the end user. For the same reason, they can be less "user-friendly" and not as easy to use because less attention is paid to developing the user interface. There may also be less support available for when things go wrong – open source software tends to rely on its community of users to respond to and fix problems. Although the open source software itself is mostly free, there may still be some indirect costs involved, such as paying for external support. Although having an open system means that there are many people identifying bugs and fixing them, it also means that malicious users can potentially view it and exploit any vulnerabilities.

1.4.2 Disadvantages of open source software

Open source software may benefit many businesses, however it can also pose several significant challenges – from unexpected costs and steep learning curve, to complex compatibility issues.

The main disadvantages of open source software relate to:

- 1. Difficulty of use** - Some open source applications may be tricky to set up and use. Others may lack user-friendly interfaces or features that your staff may be familiar with. This can affect productivity and put off your staff from adopting or using the programs with ease.

2. Compatibility issues - Many types of proprietary hardware need specialised drivers to run open source programs, which are often only available from the equipment manufacturer. This can potentially add to the cost of your project. Even if an open source driver exists, it may not work with your software as well as the proprietary driver.

3. Liabilities and warranties - With proprietary software, the developer usually provides indemnification and warranty as part of a standard licence agreement. This is because they have full control and copyright over the product and its underlying code. Conventional open source software licences typically contain only limited warranty and no liability or infringement indemnity protection.

4. Hidden costs - Software that is free up-front but later costs money to run can be a major burden, especially if you haven't considered these hidden costs from the outset.

1.5 LICENSES

The creation and ownership of knowledge products are of increasing importance because of the centrality of information and knowledge to post-industrial economies. Those who control copyright have a significant advantage in the emerging, knowledge-based global economy. There are over 40 different open source licensing agreements.

1.5.1 GPL

The GPL is the most widely-used open source software license and is considered the most “purest” by requiring that all software code is free and available and that changes must be shared with the community. Linux is available under the GPL license.

1.5.2 BSD

The BSD (Berkeley Software Distribution) License, adopted by Berkeley Unix, requires copyright notification, and permits the source to be used in any manner, as long as notification is provided. FreeBSD, Postgres SQL, and Apple’s OS X are based on the BSD licensed technology

1.5.3 MPL

The MPL (Mozilla Public License) provides for code that can remain proprietary under very specific terms, and is among the most flexible licenses. Mozilla and Firebird browsers are available under this license.

1.5.4 CC

A Creative Commons (CC) license is one of several public copyright licenses. A CC license is used when an author wants to give people the right to share, use, and build upon a work that he has created. CC provides an author flexibility. There are several types of CC licenses. The licenses differ by several combinations that condition the terms of distribution.

1.6 ODK(OPEN DATA KIT)

Open Data Kit is used to collect data for social good in difficult environments. Data collection is a key component of social good efforts ranging from polio elimination to rainforest conservation and Open Data Kit (ODK) helps thousands of organizations collect data quickly, accurately, offline, and at scale. Users of ODK software include Red Cross, World Health Organization, Centers for Disease Control, Jane Goodall Institute, Gates Foundation, the Carter Center, and many others.

ODK provides an out-of-the-box solution for users to:

1. Build a data collection form or survey (XLSForm is recommended for larger forms);
2. Collect the data on a mobile device and send it to a server; and
3. Aggregate the collected data on a server and extract it in useful formats.

Open Data Kit (ODK) is an open-source suite of tools that helps organizations author, field, and manage mobile data collection solutions. It is designed to be used in resource-constrained environments with challenges such as unreliable connectivity or power infrastructure. ODK Collect is part of Open Data Kit (ODK), a free and open-source set of tools which help organizations author, field, and manage mobile data collection solutions. ODK Collect renders forms into a sequence of input prompts that apply form logic, entry constraints, and repeating sub-structures. Users work through

the prompts and can save the submission at any point. Finalized submissions can be sent to (and new forms downloaded from) a server. Currently, ODK Collect uses the Android platform, supports a wide variety of prompts (text, number, location, multimedia, barcodes), and works well without network connectivity.

1.7 OPENMRS:

OpenMRS is an open source software that serves as an electronic medical record system (EMR). Open-source software (OSS) is computer software with its source code made available with a license which provides the rights to study, change, and distribute the software. Open-source software can be developed in a collaborative public manner.

Open Source means collaboratively open to all and source code is freely shared. The Ideas of Open source are:

- **Share the goal:** a broad group of contributors recognize the same need and agree on how to meet.
- **Share the work:** projects are broken into smaller tasks, and a review process screens the best contributions
- **Share the result:** code should be available to all and improvements should be shared to all

OpenMRS is a Java-based, web-based electronic medical record. OpenMRS is a software platform and a reference application which enables design of a customized medical records system with no programming knowledge. It is a common platform upon which medical informatics efforts in developing countries can be built. The system is based on a conceptual database structure which is not dependent on the actual types of medical information required to be collected or on particular data collection forms and so can be customized for different uses.

OpenMRS is based on the principle that information should be stored in a way which makes it easy to summarize and analyze, i.e., minimal use of free text and maximum use of coded information. At its core is a concept dictionary which stores all diagnosis, tests, procedures, drugs and other general questions and potential answers. OpenMRS is a client-server application, which means it is designed to work in an environment where many client computers access the same information on a server.

The OpenMRS API works like a black box, hiding the complexities of the data model beneath it and ensuring that applications and modules using the API work with a similar set of business rules for managing the electronic medical record system data. It has always been based on the principles of openness and sharing ideas, software and strategies for deployment and use.

OpenMRS has a modular architecture that allows modules to be easily added or removed from the system. Modules have full access to the system and can modify or enhance the behavior of the system. Module is packaged java code that can be installed into a running OpenMRS instance and is able to modify almost all aspects of OpenMRS. It can provide web pages, add tables, change how service calls work, and add new functionality.

OpenMRS is designed to be a generic medical record system that can support the care of patients, gathering observations, encounters, notes, and other data from the healthcare system and rendering those in summaries, reports, and data views that would improve the effectiveness of the people using the system.

OpenMRS is a patient-centric medical record application that records the details of interactions between health care providers and patients. Information is stored in a way that makes it easy to summarize and analyze, minimizing the use of free text and maximizing the use of coded information.

The software gathers a patient's treatment details into a single patient chart. Having this complete patient history available in one place empowers clinicians to make better decisions about care, while also enabling a deeper analysis of patient health in order to draw more meaningful conclusions on improving outcomes.

OpenMRS is based on the principle that information should be stored in a way which makes it easy to summarize and analyze, i.e., minimal use of free text and maximum use of coded information. At its core is a concept dictionary which stores all diagnosis, tests, procedures, drugs and other general questions and potential answers. OpenMRS is a client-server application, which means it is designed to work in an environment where many client computers access the same information on a server.

The OpenMRS API works like a "black box," hiding the complexities of the data model beneath it and ensuring that applications and modules using the API

work with a similar set of business rules for managing the electronic medical record system data. It has always been based on the principles of openness and sharing ideas, software and strategies for deployment and use.

The mission of OpenMRS is to improve health care delivery in resource-constrained environments by coordinating a global community that creates a robust, scalable, user-driven, open source medical record system platform.

User-Centered

- Design decisions are driven by real, not perceived needs.
- Software works in the most challenging health care delivery environments.
- It creates a platform that is adaptable to the unique needs of our users around the world.

Open Source

- It is open, honest, and transparent in both our processes and our software.
- This software serves as a platform that empowers both users and implementers to innovate.

Community-Driven

- They believe the best ideas come from people with different backgrounds and talents, and we build a community where these people can come together and innovate.
- They believe in harnessing the wisdom of our software development community by creating a safe place to raise concerns, discuss failures, improve existing ideas, and solve problems.

1.7.1 Features of OpenMRS

- Central concept dictionary: Definitions of all data (both questions and answers) are defined in a centralized dictionary, allowing for robust, coded data
- Security: User authentication
- Privilege-based access: User roles and permission system
- Patient repository: Creation and maintenance of patient data, including demographics, clinical observations, encounter data, orders, etc.

- Multiple identifiers per patient: A single patient may have multiple medical record numbers
- Data entry: With the FormEntry module, clients with InfoPath (included in Microsoft Office 2003 and later) can design and enter data using flexible, electronic forms. With the HTML FormEntry module, forms can be created with customized HTML and run directly within the web application.
- Data export: Data can be exported into a spreadsheet format for use in other tools (Excel, Access, etc.)
- Standards support: HL7 engine for data import
- Modular architecture: An OpenMRS Module can extend and add any type of functionality to the existing API and webapp.
- Patient workflows: An embedded patient workflow service allows patient to be put into programs (studies, treatment programs, etc.) and tracked through various states.
- Cohort management: The cohort builder allows you to create groups of patients for data exports, reporting, etc.
- Relationships: Relationships between any two people (patients, relatives, caretakers, etc.)
- Patient merging: Merging duplicate patients
- Localization / internationalization: Multiple language support and the possibility to extend to other languages with full UTF-8 support.
- Support for complex data: Radiology images, sound files, etc. can be stored as “complex” observations
- Reporting tools: Flexible reporting tools
- Person attributes: The attributes of a person can be extended to meet local needs.

CHAPTER 2

LITERATURE SURVEY

2.1 Reference paper 1

TITLE: Patient Record Management Information System

AUTHOR: Adewale O Adebayo, Toluhi David, Research journal's Journal of Information Technology, Vol-01, May 2014.

The purpose and essence of any records management system is to provide the right information in the right place, in the right order, at the right time for the right person at the lowest cost. This is better achieved by a computer-based system. There are some patient record management information systems (PRMISs) in existence, but they are not readily usable nor are their designs available for improvement. The main objective of this research was, therefore, to design and develop a PRMIS that would automate patient information management and give direct benefit in certain terms, whilst avoiding any confusion that would jeopardize the quality of patient care. The research strategy was design and creation, and the software development model used was the waterfall. The design and implementation of PRMIS is presented, a veritable stepping stone. Patient Management Information Systems (PMISs) are comprehensive, integrated information systems designed to manage the information of patients of a hospital and manage the service processes. Hospitals are becoming more reliant on the capability of patient management information system to assist in the diagnosis process and management, for better and improved services and practices. The main goal of PMISs is to streamline the flow of information across the hospital towards effective decision making for patient care, in an optimized and efficient manner. Recording of patient information, be it medical, personal, financial or legal, or recording of medical personnel information on paper is at risk of thievery, fire outbreaks, misplacement by employees and even petty things such as handwriting legibility. An automated PMIS will be necessary because there are a lot of difficulties in maintaining a large amount of information on paper, especially as there is usually no back-up for the information, access to information can prove difficult and time-consuming if it has to be searched for, and accuracy is needed in the recording of vital information, and chief medical personnel cannot oversee all that is written on the vast

amount of paper to be used. It is, therefore, vital for a healthcare organization such as a hospital to have an automated patient management information system. There are a number of hospital management applications, open source and non-open source, but they are usually difficult to customize or proprietary and expensive, and their designs are not readily available for appreciation and improvements. The aim of this research is, therefore, to design and create a patient record management system that would enhance information integrity, reduce transcription errors by minimizing the chances of wrong documentation, reduce duplication of information entries, optimize report turnaround time, reduce the chances of pilferage as related data would be readily available electronically, and maintain records of indoor and outdoor patients. The research strategy was design and creation (Oates, 2009). The development model employed for the project was the waterfall model (Hughes & Cotterell, 2009) because the project's requirements were clear and understood before the commencement of design and development. Interview and direct observation data collection methods were utilized at two hospitals to gather information about patient record management. In addition, extant literatures were reviewed and existing software providing similar facilities were examined for enlightenment and possible improvement. The resultant application was evaluated within certain limits. No exceptional difficulty of being ethical researcher was encountered. Effective management of information in any organization is vital for the optimal maintenance and growth of that organization. Management of information in healthcare organisation can in some cases be the difference between life and death. Hence, a healthcare organization such as a hospital will benefit from system such as the proposed, and its design is available for adoption and improvement.

2.2 Reference paper 2

TITLE: A Doctor Appointment Application System

AUTHOR: Shafaq Malik, Nargis Bibi, Sehrish Khan, Razia Sultana, Sadaf Abdul

Life is becoming too busy to get medical appointments in person and to maintain a proper health care. The main idea of this work is to provide ease and comfort to patients while taking appointment from doctors and it also resolves the problems that the patients has to face while making an appointment. The android application Mr.Doc acts as a client whereas the database containing the doctor's details, patient's details and appointment details is maintained by a website that acts as a server. If anybody is ill and wants to visit a doctor for checkup, he or she needs to visit the hospital and waits until the doctor is available. The patient also waits in a queue while getting appointment. If the doctor cancels the appointment for some emergency reasons then the patient is not able to know about the cancelation of the appointment unless or until he or she visits the hospital. As the mobile communication technology is developing rapidly, therefore, one can use the mobile's applications to overcome such problems and inconvenience for the patients. There is much work in the literature in this regard. An intelligent agent based appointment system has been proposed in which a scheduling system is provided for patients. The junior medical staff schedules appointment according to the priority level. proposed an Android application that is used to remind the patients of their dosage timings through Alarm Ringing system so that they can stay fit and healthy. Searching doctors and hospitals alongwith navigation details are also available in the app so they can get proper treatment on time. proposed an android based appointment management system which uses application programming interfaces (APIs) from Google map and calendar. This appointment based application can be used with other appointment based systems. The mobile application accepts appointments by saving the record of the appointment on the phone calendar which is synchronized with the Google calendar. The user gets an alert based on preset specified time before the appointment time and date. proposed a Health Track system that communicates with sensors via smart phone for data collection, and stores data concurrently to the central server for further analysis via the internet. Some online systems that are already functional still have some drawbacks. To overcome these drawbacks an online patient appointment system is

proposed using Near Field Communication (NFC) technique and Android enabled mobile application. This system works by registration and scheduling appointments based on NFC that accesses patient's health records and reports to alert nurses and doctors. There is another interesting work which is Disease Selfinspection and Hospital Registration Recommendation System (DSRRS). It uses Representational State Transfer (REST) style for communication interface between reasoning service and the system. Before reasoning users disease history is retrieved from Personal Health Record (PHR) and passed as an input to reasoning service. Mainly the input contains User's information, disease history, Knowledge base (symptoms) and output of reasoning service. described an android smart phones and tablets application that is freely downloadable from Google play store and it provides various functionalities including personnel medical records, to trace position of actual user in real-time. Routing algorithm is used to find minimum distance for destination building. Another study consists of an online database for the monitoring of patient with artificial heart. This database consists of monitoring terminal that is portable and keeps continuous record of a patient including history. There are other studies which involve handheld healthcare and efficient algorithms for appointment scheduling including selfinspection.

CHAPTER 3

BAHMNI

3.1 INTRODUCTION TO BAHMNI

Bahmni is a highly configurable and modular system, it can be implemented in phases and in different ways to support hospital operations. Bahmni can be setup with all or only some of the sub-products. It is meant to be implemented considering hospital's setup and the end user capabilities and use cases. For example, in a hospital which has outsourced Laboratory can choose to not install and setup OpenELIS.

It is possible for a hospital or clinic to start with a basic implementation and then keep increasing the adoption in the facility. For example, one may start with Non-clinicals first and then introduce basic clinical entry in some departments. And as the comfort level of clinicians and other staff goes up, move to capturing more details directly in the system. Here are some example scenarios in which Bahmni is being used currently.

3.1.1 Non-Clinical Implementation

In this setup Bahmni is used primarily for managing hospital's operations and not for any clinical purposes. The setup involves using Bahmni for Registration, Laboratory, Billing and Administrative Reporting.

Key business processes:

- Patient Registration is done using the Non-Clinical Implementation system.
- orders given on paper - Enter samples and Lab results in the system- Laboratory.
- paper based prescription - Enter drug orders in the system, dispense drugs, generates bill and manage inventory- Pharmacy.
- paper orders - Enter services availed, products consumed (OPD & IPD) and generate bills from paper based records- Billing.

3.1.2 Basic Clinical Implementation

Key Business Processes:

- Patient Registration is done using the basic clinical implementation system.

- Basic Clinical entry is done in Diagnosis, clinical history or specific observations system.
- Laboratory - Based on orders given on paper - Enter samples and Lab results in the system.
- paper based prescription - Enter drug orders in the system, dispense drugs, generates bill and manage inventory-Pharmacy.
- paper orders - Enter services availed, products consumed (OPD & IPD) and generate bills from paper based records-Billing.
- Doctors get to see clinical history on patient dashboard based on data entered by other departments

3.1.3 Basic Clinical Implementation - Data Entry

In this setup Bahmni is used for managing hospital operations and for clinical data entry at the end of the visit. The setup involves using Bahmni for Registration, Laboratory, Pharmacy and / or Billing and Reporting. Clinical information is captured in post facto Data Entry mode

Key Business Processes:

- Patient Registration is done using the basic clinical implementation-data entry system.
- Clinicians enter all clinical details on paper including diagnosis, prescriptions order etc.
- Based on orders given on paper - Enter samples and Lab results in the system-Laboratory.
- paper based prescription - Enter drug orders in the system, dispense drugs, generates bill and manage inventory- Pharmacy.
- paper orders - Enter services availed, products consumed (OPD & IPD) and generate bills from paper based records- Billing.
- All Clinical entry is done by a data entry operator at the end of the visit (same day or next day) - e.g. Diagnosis, clinical history, observations, prescriptions, clinical notes etc. Some of the non-structured clinical details continue to be present on paper.

3.1.4 Complete Implementation

In this setup Bahmni is used for Clinical activities as well as for managing hospital operations. The setup involves using Bahmni for Registration, Clinical (OPD & IPD), Laboratory, Pharmacy and / or Billing and Reporting.

Key Business Processes:

- Patient Registration is done using the Complete Implementation system.
- Clinicians enter all clinical details in the system including Vitals, clinical history, diagnosis, prescriptions, Lab & radiology orders etc.
- orders given by doctors in the system - accept samples and enter Lab results in the system- Laboratory.
- prescription given by doctors in the system - drug orders are pre-populated in the system, dispense drugs, generates bill and manage inventory- Pharmacy.
- Based on clinical orders and some paper based consumption entries - Some of the services and items consumed are pre-populated - for others, enter services availed, products consumed (OPD & IPD) and generate bills from paper based records- Billing.
- Some of the non-structured clinical details including Nursing and Doctor's notes in IPD continue to be present on paper

3.1.5 Program Specific Implementation

In this setup Bahmni is used for capturing disease specific program data. The setup involves using Bahmni for Registration and capturing program specific Clinical data and Reporting. This typically involves installing Bahmni with only OpenMRS.

This could be done during patient visit or as a post facto data capture

Key Business Processes:

- Patient Registration is done using the Program Specific Implementation system.
- Program enrollment, Managing program progress and End programs.
- Capturing program specific observation forms

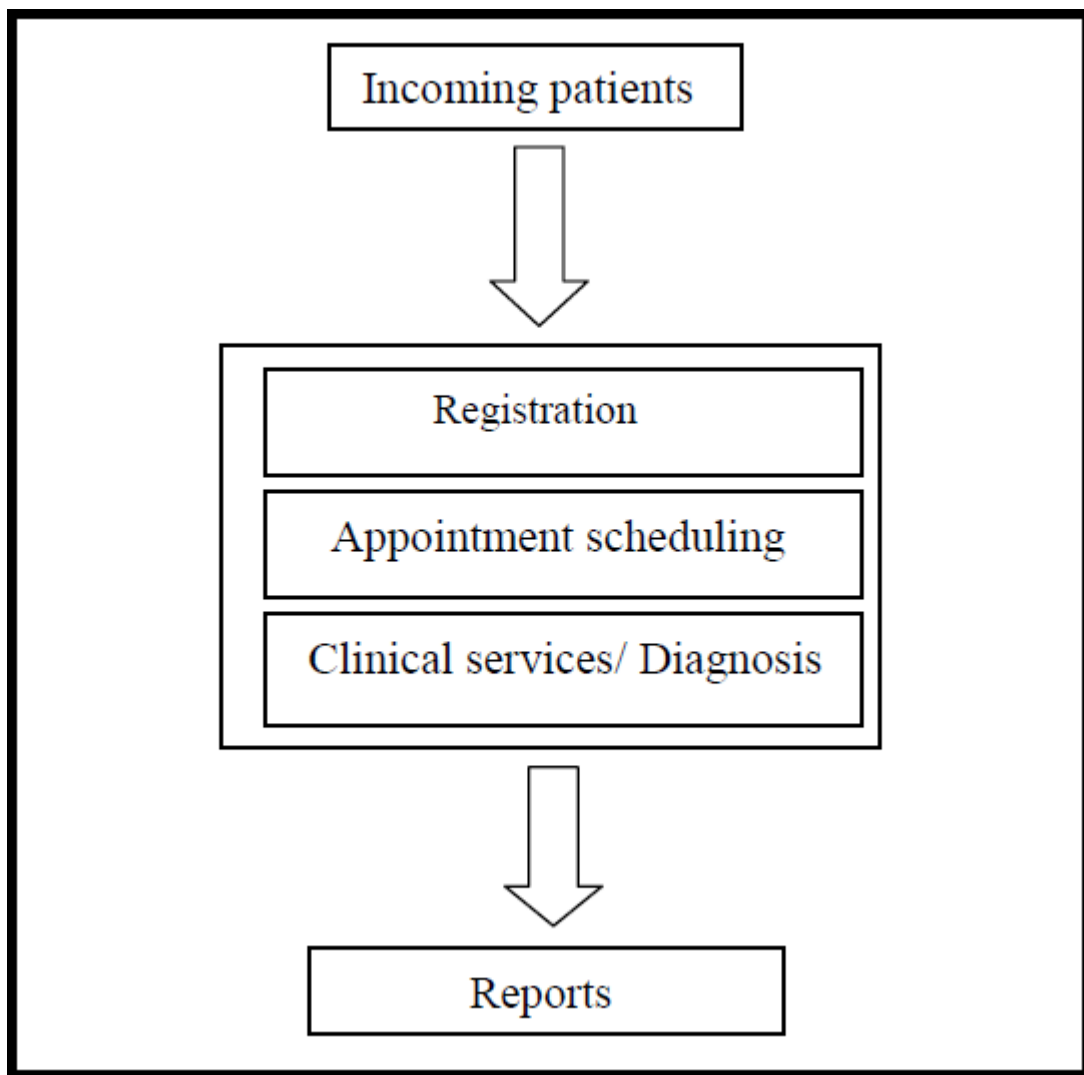


Fig- 3.1: Block diagram

3.2 MODULES

3.2.1 Patient Registration

Patient Registration provides the ability to start and edit a patient file at a hospital. Most hospitals have a front desk where patients have to register before starting medical interactions such as consultation, lab tests, admission, procedures etc. The Registration Module in Bahmni is designed to be used at the front desk to capture patient information that can be collected by non-clinical staff.

Using the Bahmni Registration Module, users can search for existing patients and add new patients to the system. For every patient record being created, information such as patient name, photograph, address and specific attributes that the hospital may be interested in can be captured. This information can be printed out as an identification

card for the patient, which can be configured. There is a provision in the Registration module for the user to specify which department or doctor the patient is being directed to. This can later be used to configure custom queues for that specific department / doctor.

The Registration module can also be configured to capture clinical information for the patient such as height and weight, which can later be shown to clinicians, if the current hospital workflow demands it.

Where is it Used?

At the front desk of the hospital, this is the first touch-point for the patient in the hospital, where the patient record is created or updated.

Benefits

- Configurable patient search based on name, identifier, address or custom attributes.
- Capture of patient details (multiple identifiers, name, age, gender, photograph, custom attributes).
- Patient's address details (optionally a pre-defined location hierarchy can be used)
- Capture relationships between patients and other patients/doctors
- Print out custom configurable patient identification cards
- Drive patient workflow in other departments of the hospital based on information collected
- Ease facility management by tracking the number of times a patient visits a hospital and the kind of encounters he/she goes through during a particular visit.

3.2.2 Treatment Programs

A Program is a feature that is typically used when a patient is identified as belonging to a group which needs regular consultations or interventions. For example, programs might be used for diseases such as HIV, tuberculosis or even conditions such as

pregnancy or interventions such as childhood immunization. These are situations that demand periodic monitoring to ensure that the patient is progressing on the right path.

Other important reasons for using a program are for situations where entry and exit dates of a patient into a program are required for reporting purposes and to trigger specific workflows. Using Bahmni, a program can be defined with a specific workflow and patients can be enrolled into this program. The patient's state changes over a timeline can be easily visualized. Separate reports can be generated for encounters within a program and for encounters that are not part of the program.

With the program module, it is possible to :

- Enroll a patient to a program
- Track patient progress
- Remove a patient from the program

Where is it Used?

Hospitals which run programs involving frequent/periodic followups for specific diseases or conditions (eg. TB care or Pre/Post Natal Care).

Benefits

The program module is useful in monitoring patients with diseases that require prolonged/extended treatment. It helps in monitoring when the patient enrolled in the program and keeps track of their progress over time. This is also useful in generating reports to check efficacy of a particular treatment regimen for a patient.

3.2.3 Clinical Services

The Clinical Services feature is used to view the treatment history of existing patients, as well as to start a registered patient's treatment process in the medical facility.

Where is it Used?

It is used in the hospital to start a registered (new or repeat) patient's clinical observation and consultation process during the course of the patient's treatment. It is also used to search for, view and edit a patient's observation notes.

Benefits

- Enter Patient data retrospectively or on behalf of another provider.
- View Patient Dashboard including Patient Details, Active and Past Programs, etc.
- View the summary of a Patient's visit along with graphs and trend mapping.
- Capture specific clinical observations for the patient such as Obstetrics, Gynecology, etc.
- Autocompletes most data fields for easier data entry.
- Capture various diagnoses for the patient.
- Capture Dispositions for the patient with Disposition notes.
- Capture Consultation notes for the patient.
- Prescribe treatment orders for medications.
- Place orders for radiology tests via PACS (Picture Archiving and Communication System) integration.
- Place orders for Laboratory tests.
- View the consultation history of the patient.
- View scanned documents and results of tests.
- Capture Bacteriology test results for the patient (different from laboratory tests). Bacteriology includes smear test results, culture test results and drug-sensitivity test results.
- View Patient Lists with support for sorting by filters.

3.2.4 Patient Lists

This feature provides a list of patients registered at the facility with filtering capabilities. Using this list, the staff at the hospital can navigate to the Patient Dashboard to view and add clinical information for the patient.

Where is it Used?

Patient lists are mainly used as springboards for viewing and capturing clinical information of the patient. Patient lists are supported in all modules in Bahmni, including Clinical, Program Management, In-Patient, Orders etc. These lists can be configured to be displayed either as tiles or as a list with configurable information per patient.

Benefits

Patient Lists bring multiple benefits to the hospital staff -

- A quick snapshot of patients in various categories, either as a tile or list view.
- The tile view displays the patient picture, if the patient image has been captured in the registration module. If the patient is admitted, the tile view also displays an icon indicating the patient is admitted.
- In the list view, a configurable set of information for each patient can be displayed.
- Additionally, the queues themselves are configurable, and can be setup based on different parameters. For example a list of all patients who have an active visit or all patients who have been sent to a particular department.

3.2.5 Patient Dashboard Overview

The Patient Dashboard displays an overview of a patient's clinical personal information. This page, which has configurable sections, is used to display the most crucial information of the patient to enable quick and efficient care. Some of the information usually displayed on the Patient Dashboard may include patient diagnosis history, lab results, nutritional values, vitals, treatments, radiology documents etc.

Bahmni provides the ability to configure multiple such dashboards per patient, which in turn gives users the option to view information which can be classified and organized based on their needs. Additional dashboards can be setup, for example to view graphical trends of numeric observations or a department specific view of patient clinical data.

Bahmni supports various display control widgets that can be added and configured to display relevant patient information. A display control takes in configuration that specifies the context (patient, visit, etc.) and other parameters (display specific feature toggles), retrieves relevant data on its own and displays it based on where it is placed on the application.

Where is it Used?

Dashboards are used to display patient information as relevant to the context. These can be configured to view the clinical and other required information about the patient.

Benefits

The following are the main benefits of dashboard:

- View patient information using display control widgets.
- View a complete snapshot of patient clinical information either at the level of a patient or a visit.
- Configure patient graphs and trends for convenient metrics and monitoring.

3.2.6 Patient Graphs and Trends

When doctors use Bahmni to look at data for patients, it is very useful for them to look at certain observations as graphs or trends so that they can get an idea of how the patient is faring with the given treatment. This is clearly represented in the Trends tab in the clinical module.

Where is it Used?

The Trends dashboard is used by the doctors at the time of consultation to quickly refer to how the patient has been doing in the key areas over a period of time.

Benefits

- This information is conveyed quickly when the data is visualised as a graph instead of a table.
- Clinicians can also view growth charts and reference charts in Bahmni
- Examples of charts that are used at various hospitals are - for a diabetes patient the clinician can view the trend chart of their blood sugar levels over a period of time., for a TB patient the weight and BMI charts are used to see the trend over the period of the treatment.
- For babies, growth charts can also be setup and the clinicians can easily make out which percentile the baby is in.

3.2.7 Patient Monitoring Flowsheet

There are several treatments or programs that are run by medical organisations that require the patients to adhere to a particular order of visits, tests or other checks that are conducted as per a schedule. In such scenarios, the patient monitoring flowsheet gives a visual representation of the following:

- The planned treatment schedule for the patient
- The patient's position in the treatment schedule as of today
- Missed or erroneously captured data

This flowsheet is driven by a trigger that would define the beginning of the schedule. For instance, this could be a date like the date of enrolling the patient into a program or it could be an event, for instance birth of a child. The schedule of what needs to be recorded and when will be defined at a local level by the implementers in the configuration.

Where is it Used?

Some examples where this might be useful are diseases like HIV, TB etc, antenatal and postnatal programs or immunisation schedules. This display is meant for the end users who would want to look at the flowsheet and determine if the patient's data is complete as per the schedule. These users might be clinicians, program managers or data managers.

Benefits

This feature helps ensure data quality for a patient in terms of data entry. Further it provides a one shot view of the progress of a patient in a particular treatment schedule or program.

3.2.8 Capturing Consultation Data

The Observations tab in the clinical module in Bahmni is a platform where clinicians can record and view clinical notes for general patients, emergency cases, surgery, vitals, intake-output, delivery, gynecology, and basically every disease or condition for which forms have been defined.

Where is it Used?

It is used in the hospital to start a registered (new or repeat) patient's clinical observation and consultation process during the course of the patient's treatment. It is also used to search, view and edit a patient's observation notes.

Benefits

- Enter Patient data retrospectively or on behalf of another provider.
- View Patient Dashboard including Patient Details, Active and Past Programs, etc.
- View the summary of a Patient's visit along with graphs and trend mapping.
- Capture specific clinical observations for the patient such as Obstetrics, Gynecology, etc.
- Autocompletes most data fields for easier data entry.
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- Prescribe treatment orders for medications.
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- Place orders for Laboratory tests.
- View the consultation history of the patient.
- View scanned documents and results of tests.
- Capture Bacteriology test results for the patient (different from laboratory tests). Bacteriology includes smear test results, culture test results and drug-sensitivity test results.
- View Patient Lists with support for sorting by filters.

3.2.9 Capturing Observations

The Observations tab in the clinical module in Bahmni is a tab in the clinical consultation where clinicians can capture clinical observations for patients. The different forms used in different departments and sections by different providers in a hospital can be setup here as individual forms. Examples of such may be surgery, vitals, intake-output, delivery, gynecology, ANC, diabetes etc. Bahmni provides the

ability for the users to recall data previously filled in these forms, mark their favorite forms and compute drug orders automatically. Observations can be captured in various data formats including free text, numeric, boolean, drop-down with auto-complete ability, date, single select, multi select, grid etc. These forms can be created and edited by the implementer either manually using the OpenMRS administrator's interface or the custom CSV file import mechanism.

Where is it Used?

The Observations tab is mainly used by doctors and data entry personnel to record observations for a patient during a visit. These observations are captured across different forms that are configured for the hospital facility.

Benefits

This tab plays a key role in capturing patient's clinical information. The information is entered in forms that are exclusively set up for various diseases or conditions that a patient may have. For example, a facility can define a form for diabetes. This form would contain a list of all the questions that a doctor would need to ask a patient suffering from diabetes. Some questions can be populated with a pre-defined list of possible answers. This helps the doctors ensure that they have covered all the core questions that they need to ask the patient.

3.2.10 Recording Diagnosis

Diagnosis is the most important clinical information of a patient. Bahmni provides the ability to capture, edit and delete diagnoses for patients on a diagnosis tab inside clinical consultation. Clinicians can use this feature to capture diagnosis of patients and manage their old diagnoses. In the database these diagnoses can be mapped to ICD-10 codes for reporting purposes. Bahmni allows users to configure your own attributes for each diagnosis, such as inactive, ruled out, etc.

Where is it Used?

The Diagnosis tab is used mainly by the clinicians to record the diagnosis of the patient. If the diagnosis being entered has not been saved as part of the coded set of diagnoses in the database, the clinician can save the diagnosis as a "non coded" diagnosis by Accepting it as a new diagnosis being entered. Along with the diagnosis,

the clinicians can also indicate whether a diagnosis is primary or secondary and if it is presumed or confirmed. In addition to this, they can also rule out or mark a diagnosis as inactive if applicable. Additional notes can also be entered against each diagnosis. Clinicians can also delete or edit past diagnoses on this tab.

Benefits

The Diagnosis tab provides the history of diagnoses of a patient at one place. This is important for clinicians to understand a patient's clinical history. It is particularly helpful for the clinicians as it provides a quick snapshot of previous diagnoses.

3.2.11 Ordering Laboratory and Radiology Tests

Using this feature, a doctor can place lab orders and procedure orders from clinical module. The procedure orders placed can then be viewed, relevant information can be added and it can be marked as completed. For lab orders, integration is built between the clinical (OpenMRS) and lab (OpenELIS/Odoo) systems to enable the lab dashboard to be auto-populated based on the order from the Clinical module.

Where is it Used?

The need for an Order arises when the doctor or any other medical provider wants some action to be taken by some other medical provider in the Hospital for a particular patient. The work flow would be as follows:

- The Medical practitioner who wants to place an order goes to the tab "Orders" under Clinical Consultation.
- The Orders tab lists all the possible types of orders (this can be configured).
- Once an Order type is selected, all the concepts that are needed to specify that particular type of order are listed in a hierarchical manner from where they can be selected for specifying the order
- This Order then resides in a queue which contains all the orders. The orders will be fulfilled through different views of this queue.
- The Orders fulfillment is set up as a separate module in the application. Clicking on the icon for this module will take the user to a page where all the pending orders are listed in different queues based on their order types.

Benefits

This allows the clinician to place an order from the system. The lab technician can immediately see the order in their queue and hence they do not have to wait until the patient comes to know what samples need to be collected or tests need to be done.

3.2.12 Prescribing Medications

The Medications tab in the Clinical module in Bahmni is a platform where clinicians can prescribe drug/medication orders to the patients. They can also manage old prescriptions for the patient here. A drug order can be added, edited, stopped or refilled on the Treatments tab. For each drug order, the system allows the clinicians to choose route, frequency, dosage and instructions. This feature has been designed to make the users highly time efficient, by providing them sensible defaults wherever possible.

Where is it Used?

The Medications tab is used by the clinicians to capture what medicines they have prescribed to the patient. In some cases, it is also used to indicate the medicines that the patient was on.

Benefits

- The Medications tab provides an easy way to order drugs for a patient.
- It has key features like edit, stop and refill a drug order, all of which simplify management of drug orders.
- The tab provides a clear visual distinction of the current active, scheduled and past drugs. The drug orders with a green tag are scheduled, the ones with an orange tag are those that are currently active and the ones without any tag are the past drug orders of that patient.
- It can also be configured to group drug orders into sub-sections if desired by the hospital/clinicians.

3.2.13 Dispensing Drugs

This feature provides the ability to mark the drugs as dispensed against a drug order. In most scenarios this is done by the person dispensing the drugs - pharmacist(s) or doctor(s).

This feature additionally helps to provide clear segregation of stocks, so that the inventory can be managed well in OpenERP. This is achieved by mapping login location to shops. The quotation gets created in the pharmacy that is mapped to the location from where the drug is dispensed.

Where is it used?

This feature is used either by the clinician or the pharmacist to mark the drugs as dispensed after providing the drugs to the patients. There are scenarios where apart from the pharmacy, the drugs can be stocked at different locations within the hospital. In such cases, this feature provides a finer mechanism to mark only those drugs which have been dispensed from the current location of the clinician or pharmacist. A typical use-case would be if the physician dispenses the "physician's free sample" so that the cost of treatment can be lowered for the given patient. The physician can click on the "D" button which is mapped to a "discount shop" in OpenERP. The pharmacist then can dispense only those drugs which the physician has not given to the patient.

Benefits

The major benefits of this feature are:

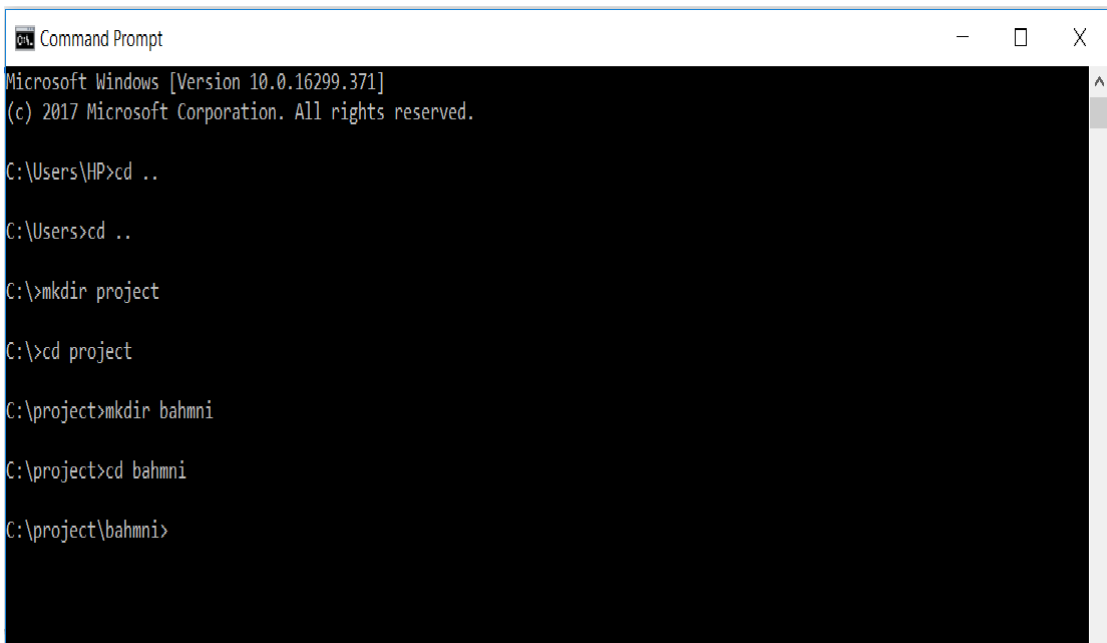
- Ability to mark the drugs as dispensed.
- Manage drug stocks at different locations within the hospital - e.g.: pharmacy (one or more), OPD (one or more), other locations, etc.
- Provide a clear separation of quotations in OpenERP for different OpenMRS locations.

CHAPTER 4

INSTALLATION OF BAHMNI

4.1 IMPLEMENTATION PROCEDURE OF BAHMNI

- Install Git.
Git: <http://git-scm.com/book/en/v2/Getting-Started-Installing-Git>
- Next install VirtualBox.
VirtualBox: <https://www.virtualbox.org/wiki/Downloads>
- Next install Vagrant box.
Vagrant: <https://www.vagrantup.com/downloads.html> (Please install newer Vagrant version)
- Open Command Prompt.
- Create a directory as Projects(any name).
- Cmds: `mkdir Projects` (enter).
- Change the directory: `cd Projects`(enter).
- Create a folder in projects, name it as Bahmni
- Cmds: `mkdir Bahmni`(enter).
- Change the directory: `cd Bahmni`(enter).

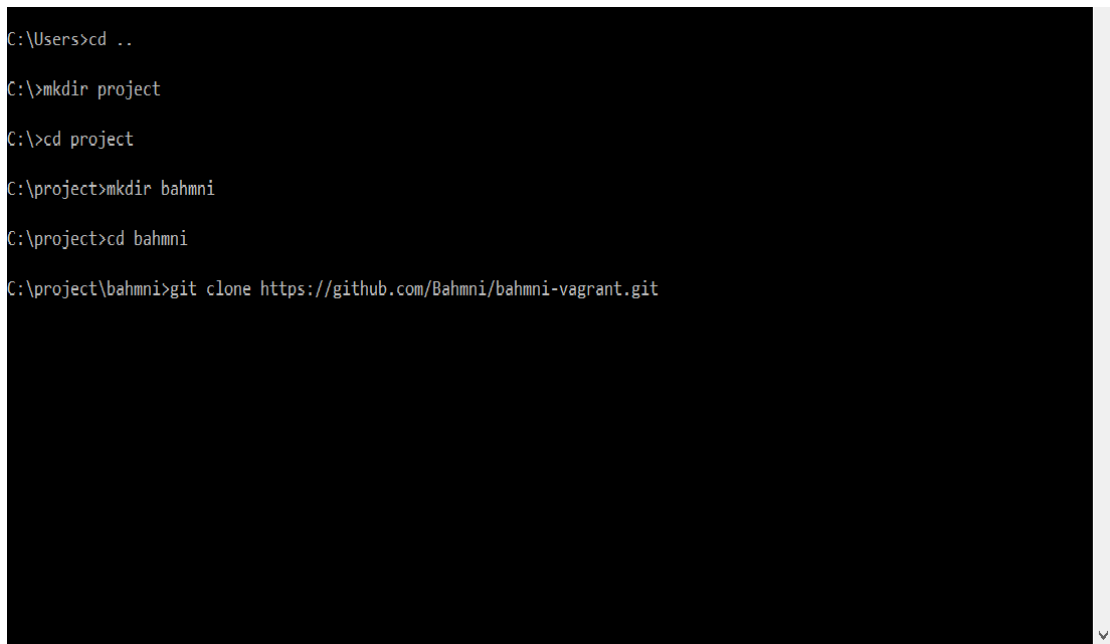


```
Microsoft Windows [Version 10.0.16299.371]
(c) 2017 Microsoft Corporation. All rights reserved.

C:\Users\HP>cd ..
C:\Users>cd ..
C:\>mkdir project
C:\>cd project
C:\project>mkdir bahmni
C:\project>cd bahmni
C:\project\bahmni>
```

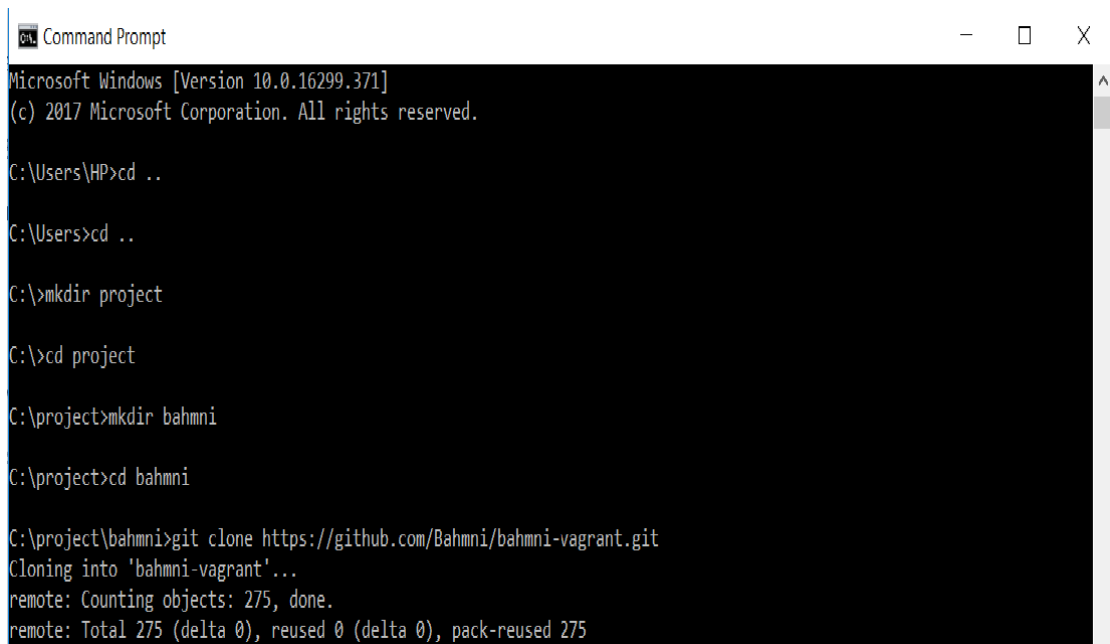
Fig- 4.1: Creating directories

- Clone the code from the git by using the command
git clone <https://github.com/Bahmni/bahmni-vagrant.git>.



```
C:\Users>cd ..  
C:\>mkdir project  
C:\>cd project  
C:\project>mkdir bahmni  
C:\project>cd bahmni  
C:\project\bahmni>git clone https://github.com/Bahmni/bahmni-vagrant.git
```

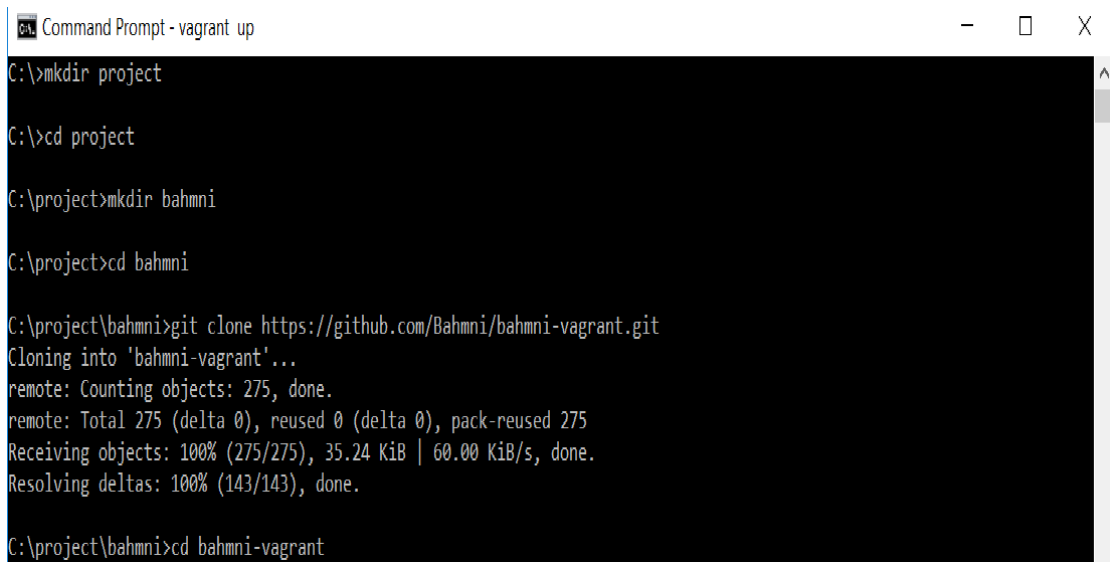
Fig- 4.2: Deploying bahmni source code



```
Microsoft Windows [Version 10.0.16299.371]  
(c) 2017 Microsoft Corporation. All rights reserved.  
  
C:\Users\HP>cd ..  
C:\Users>cd ..  
C:\>mkdir project  
C:\>cd project  
C:\project>mkdir bahmni  
C:\project>cd bahmni  
C:\project\bahmni>git clone https://github.com/Bahmni/bahmni-vagrant.git  
Cloning into 'bahmni-vagrant'...  
remote: Counting objects: 275, done.  
remote: Total 275 (delta 0), reused 0 (delta 0), pack-reused 275
```

Fig- 4.3: Cloning into bahmni-vagrant

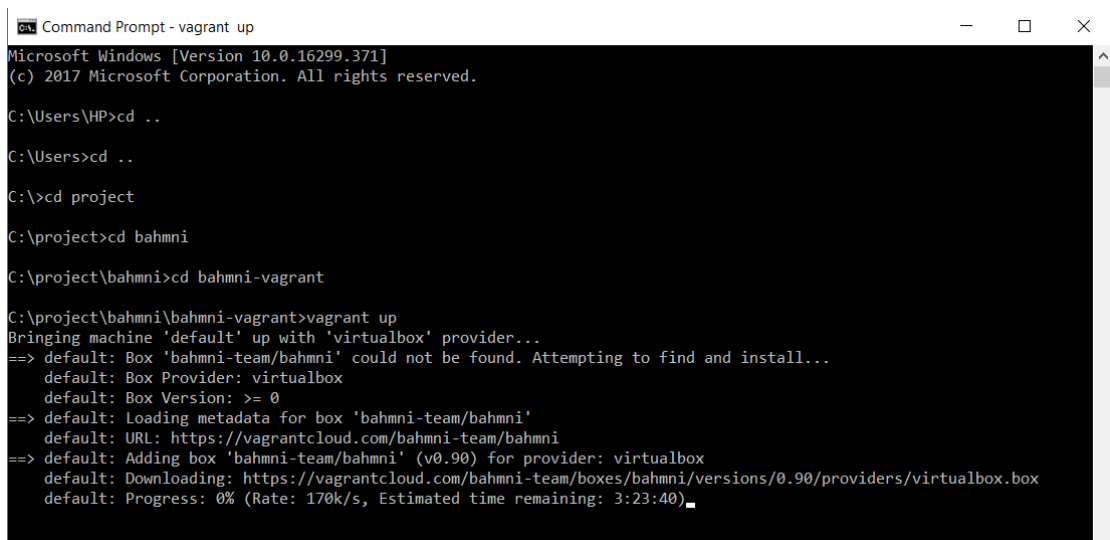
- Now type command as: cd bahmni-vagrant(enter).



```
Command Prompt - vagrant up
C:\>mkdir project
C:\>cd project
C:\project>mkdir bahmni
C:\project>cd bahmni
C:\project\bahmni>git clone https://github.com/Bahmni/bahmni-vagrant.git
Cloning into 'bahmni-vagrant'...
remote: Counting objects: 275, done.
remote: Total 275 (delta 0), reused 0 (delta 0), pack-reused 275
Receiving objects: 100% (275/275), 35.24 KiB | 60.00 KiB/s, done.
Resolving deltas: 100% (143/143), done.
C:\project\bahmni>cd bahmni-vagrant
```

Fig- 4.4: Change directory to bahmni-vagrant

- Finally enter the command as: `vagrant up`(enter). It takes some time to complete the download.



```
Command Prompt - vagrant up
Microsoft Windows [Version 10.0.16299.371]
(c) 2017 Microsoft Corporation. All rights reserved.
C:\Users\HP>cd ..
C:\Users>cd ..
C:\>cd project
C:\project>cd bahmni
C:\project\bahmni>cd bahmni-vagrant
C:\project\bahmni\bahmni-vagrant>vagrant up
Bringing machine 'default' up with 'virtualbox' provider...
==> default: Box 'bahmni-team/bahmni' could not be found. Attempting to find and install...
default: Box Provider: virtualbox
default: Box Version: >= 0
==> default: Loading metadata for box 'bahmni-team/bahmni'
default: URL: https://vagrantcloud.com/bahmni-team/bahmni
==> default: Adding box 'bahmni-team/bahmni' (v0.90) for provider: virtualbox
default: Downloading: https://vagrantcloud.com/bahmni-team/boxes/bahmni/versions/0.90/providers/virtualbox.box
default: Progress: 0% (Rate: 170k/s, Estimated time remaining: 3:23:40)
```

Fig- 4.5: Running vagrant box

- After sometime open the google chrome and type the url as: <https://192.168.33.10/home>.

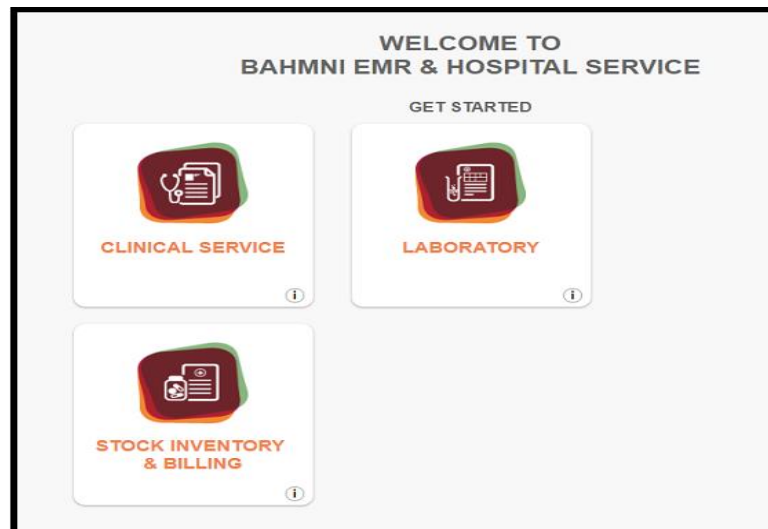


Fig- 4.6: Bahmni Services

- Click on Bahmni Erp and Login with credentials

Username: superman

Password: Admin123

Fig- 4.7: Login screen

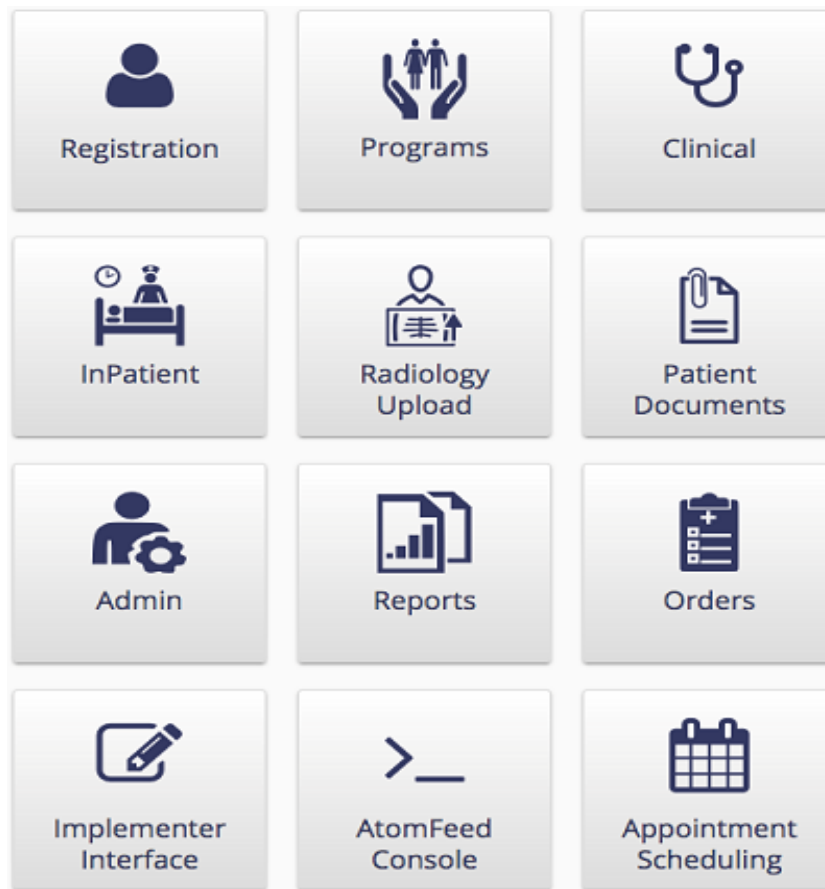


Fig- 4.1.8: Bahmni Home page

- **Note:** For best practice use google chrome only. After entering the url if it shows as untrusted connection or not supported just click on Advanced and click on proceed then the Bahmni home page will be opened.
- If any errors occurs while mounting the vagrant box on virtual box then type the command as: `vagrant up --provider = virtualbox`.
- If any errors occurred with the version of the virtual box then update the virtual box version.
- If you want to modify the source code of the Bahmni for implementing, then open virtual box and run the Bahmni-RPM.
- Cmd: `cd /var/www/bahmni_config/openmrs/apps/` and type `ls` then list of files will be displayed in that change directory to `applications.json` and view the modules like `registration.json`, `clinical.json`, etc.

4.2 USE CASE IMPLEMENTATION

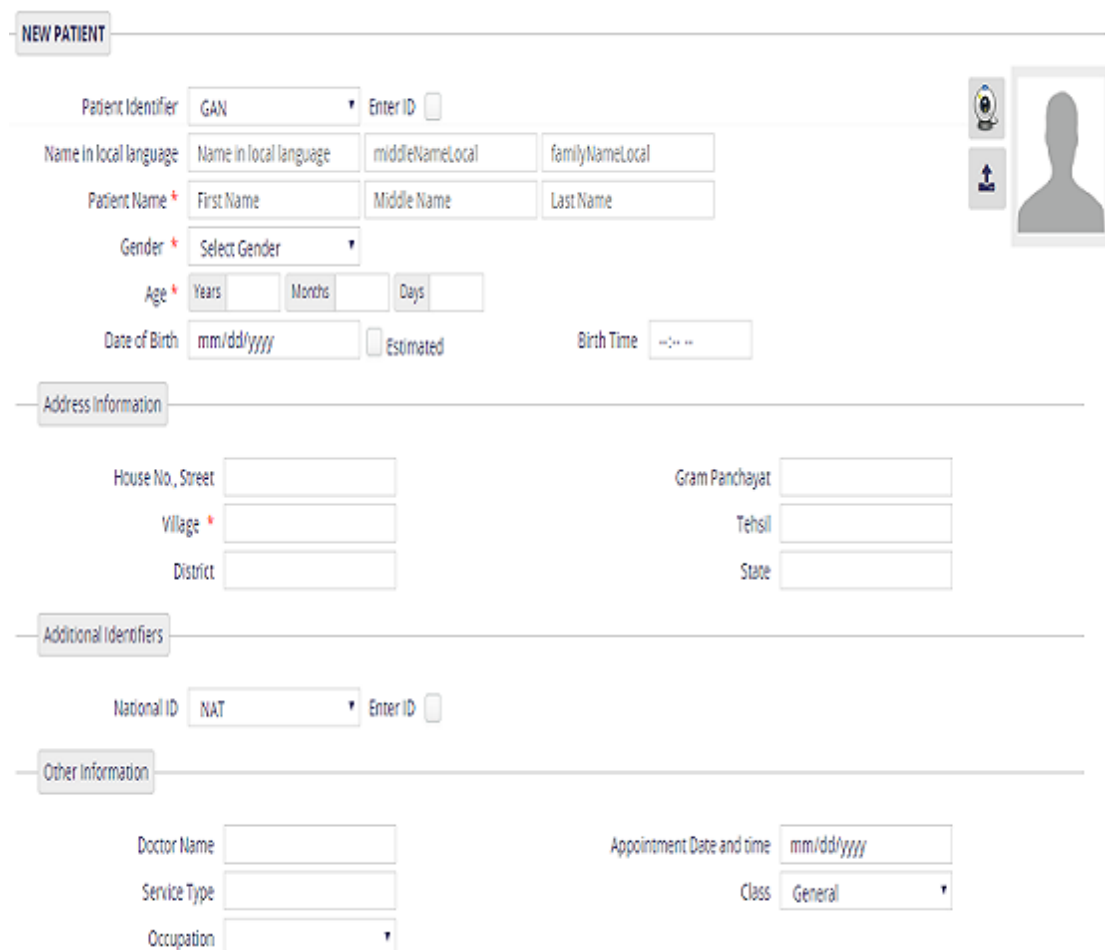
- Collect the data of the patients in a excel sheet(.csv file format) who visit the hospital in the form of Registration No, First Name, Middle Name, Last Name, Gender, Location.
- Open Bahmni setup. Login using the credentials
Username: superman.
Password: Admin123(default we can change).
Location: Registration Desk.
- Now in Home page click on admin tab, and again click on upload csv.
- Then a page will be displayed click on the patient checkbox and upload the file from local system.
- After uploading we can directly search the patient records by using their Registration No. Now this will be connected with appointment scheduling module.
- Go to home page click on Appointment scheduling module. We can create the new appointments for the patients, manage the appointments of the patients and also can check the status of the patients whether they have consulted the doctor or not.
 - If patient visits hospital for the first time then create the appointment and provide the doctor who are available.
 - If required doctor is not available then manage the appointment by changing the provider's name.
 - We can change the status whether the patient have completed their check up or still not completed. We can generate the graphs to know the status and pending appointments.
- After completing all the process if we wants to generate the reports click on reports module and enter the start date, end date and format (in which format to download the reports eg: html, pdf, docx, csv, etc). We can generate daily reports or from certain period to period.

We have other modules like Odoo for billing, OpenElis for laboratory Management, Ward Management and other modules which can be helpful for the staff.

CHAPTER 5

RESULTS

The patient registration helps the patient to register for the treatment and in this we have to provide the doctor's information for which doctor we the patient have to consult. While registering the patient, we have to allocate the available doctor and give the appointment at what time they have to consult the doctor and the service type for which reason they have to consult the doctor. After that Patient Diagnosis is happening through the provider allocated to them. If the hospital management staff wants to generate the daily basis, weekly basis reports, what are the medicines provided, etc.,



The form is titled "NEW PATIENT" and is divided into several sections. The first section, "Patient Information", includes fields for Patient Identifier (GAN), Enter ID, Name in local language (Name, middleNameLocal, familyNameLocal), Patient Name (First Name, Middle Name, Last Name), Gender (Select Gender), Age (Years, Months, Days), Date of Birth (mm/dd/yyyy, Estimated), and Birth Time. The second section, "Address Information", includes fields for House No., Street, Village, District, Gram Panchayat, Tehsil, and State. The third section, "Additional Identifiers", includes fields for National ID (NAT) and Enter ID. The fourth section, "Other Information", includes fields for Doctor Name, Service Type, Occupation, Appointment Date and time (mm/dd/yyyy), and Class (General). There is also a profile picture upload icon and a placeholder image on the right side of the form.

NEW PATIENT

Patient Identifier: GAN Enter ID ☐

Name in local language: Name in local language middleNameLocal familyNameLocal

Patient Name: First Name Middle Name Last Name

Gender: Select Gender

Age: Years Months Days

Date of Birth: mm/dd/yyyy Estimated Birth Time: --:--

Address Information

House No., Street Gram Panchayat

Village Tehsil

District State

Additional Identifiers

National ID: NAT Enter ID ☐

Other Information

Doctor Name Appointment Date and time: mm/dd/yyyy

Service Type Class: General

Occupation

Fig- 5.1: Patient Registration form.

ID	National ID	Name	Given Name Local	Middle Name Local	Family Name Local	Gender	Age	Gram Panchayat	Registration Date
GAN203006	NAT2804	Priya S				F	21		12 Apr 18

Fig- 5.2: Searching for Patient

Priya S (GAN203012) - Female, 21 Years 11 days
MADAN, Korba

Date of Birth: 02 Apr 97

Home Dashboard | Patient Visit Page | Patient ADT Page | Program Management Page | Visit Attributes | Registration

Diagnosis
No diagnosis for this patient

Visits
12 Apr 18 ★ OPD

Fig- 5.3 Patient Diagnosis Details tab

Name	Start Date *	End Date *	Format *
Visit Report	04/11/2018	04/14/2018	EXCEL

Run Now

Fig- 5.4: Inpatient Reports tab

CHAPTER 6

FUTURE SCOPE

The proposed system is Hospital Management system. We can enhance this system by including the more facilities along with the rural help. This may helps the consultant, patient, hospital staff and made easy to manage the data. Where ever the patient go the data stays and can use it for different purposes. PHC center can implement this by interconnecting the hospitals by using this technologies to make the things happen in smoother manner. Providing such services to the users will make more efficient to work.

CHAPTER 7

CONCLUSION

This application software helps the hospital members to maintain the patient data and doctor data on a local server. So, this helps the patients wherever he visits the data stays forever. While registering the patient a national id is generated, by using the national id he can visit the hospitals anywhere. This helps the hospital management staff in reducing the maintenance of records, errors while retrieving the data regarding the medicine, laboratory, and other details. If a patient visits the laboratory, then no need to give a prescription. Instead the laboratory staff can upload the details in the laboratory observations with referencing the patient ID number.

CHAPTER 8

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