**ABSTRACT**

The advent of EHRs have revolutionized the health care. Example of one such system is LibreHealth EHR system. This project summarizes the overall features, functions of this EHR system and possible challenges associated with its usability. Our team has constructed four case studies on different patients to understand the user interface and various functionalities of this EHR system. We have also explored multiple fields to add diagnosis, medication and created referrals to evaluate the ease of usability and readiness of finding the relevant data in this EHR system. We have also used online resources like Mayo Clinic to fetch information regarding the medication and dosage. In this process, we have recorded the challenges tangled around LibreHealth EHR to find solutions and improve its usage in the future. In a nutshell, LibreHealth EHR is a dynamic system proving adequate fields to record patient data and renew it whenever needed. The user interface is friendly and clean to visualize the information in a sectioned format. However, recommendations were made to improve fields like encounter tabs and appointment sections to further improve its usability.

**INTRODUCTION AND PROBLEM STATEMENT**

EHRs are useful in many facets of healthcare, including supporting clinical workflows, CDSS, enhancing patient safety, and resolving the challenges of data maintenance. All of these are possible with the apt usage of these technologies in various fields of healthcare. EHRs available today are incorporated with advanced functionalities like clinical decision support which plays a key role in improving the patient safety and health outcomes. EHR usability is primarily concerned with the quality of outcome which is determined by effectiveness and efficiency to perform the given task (Shugalo, 2022). User satisfaction is paramount for successful implementation and usability of EHRs (Shugalo, 2022). So, it is important to train and educate the users about EHR to effectively use it to its full potential. Understanding various fields in EHR is necessary to input accurate information. Good usability of these functional EHRS had resulted in ease of communication among healthcare providers with regard to interoperability and prevention of medical errors through constant alerts (Rizvi et al., 2017). Health information technology (HIT), EHRs, and patient portal are often interconnected and go hand in hand. A major challenge associated with poor EHR usability is disruption in the clinical workflow and care coordination which can result in user frustration and productivity loss (Rizvi et al., 2017). Healthcare providers often experience burnout if proper training is not advocated to them (Khairat et al., 2019). The initial set up of EHR is quite expensive, improper usage can result in suboptimal utilization and deinstallation of the equipment (Staggers et al., 2013). Compromised patient safety is another usability failure as clinical decision support and evidence-based medicine included in EHRs is not utilized while formulating the diagnosis or treatment protocols. Improper data entry in EHRs can result in prescription errors (Patel et al., 2021, p. 167).

EHRs include a lot of functionality to manage and streamline the clinical workflows. When used appropriately, this software saves a lot of time and improve the health outcomes due to their intensive documentation (The Office of the National Coordinator for Health Information Technology, 2022). Training the clinical staff on the advancements is crucial to compensate for burnout and undue stresses (Robinson & Kersey, 2018). Early education about EHRs to the clinical staff and physicians help them to understand various fields in EHR to prevent manual errors while documenting patient data and save their time to record this information (Mohan et al., 2021). This in turn can maximize the valuable clinical time of clinician with patient. When knowledge about these technologies is gained and properly understood by the healthcare providers, tools like CDSS can be used while formulating diagnosis and medical prescriptions to avoid errors to improve patient safety and health outcomes (Castaneda et al., 2015). Ease of recording this information helps the clinical staff with seamless workflows (Khan et al., 2017).

**PURPOSE**

In order to dive deeper and learn the functionalities of EHR better, we intent to perform an analysis on Librehealth EHR system. So, we have decided to conduct a usability study to justify the problem statement. To achieve this, we therefore constructed case studies on four patients with different diagnosis to interpret and understand the usability of LibreHealth EHR.

**METHODS**

LibreHealth is a multi-functional EHR system with various fields like patient, calendar, messages, procedures, administration, reports and miscellaneous. These fields help the user to fetch the information needed much quickly and navigate with ease to perform the necessary tasks. The user interface is clear and well defined with adjustable window sizes. Multi-screening with different windows is also made possible adding the user to visualize multiple information at the same time. This system also contains fields like summary of the patient, tabs to send referrals and also appointment sections which make the workflow seamless.

**Division of labor:**

Sai Varshith Reddy Gundarapu

* He took the responsibility to conduct group meetings on a timely basis and ensured coordination among team members.
* Varshith also recorded the misadventure visit of the patient in EHR system and formulated its diagnosis in accordance with ICD-10 codes.
* He also turned in the assignments before the due date.

Ashwini Dodda:

* She performed the tasks like finding the patient in LibreHealth EHR system, assigning the diagnosis and ICD-10 codes based on the clinical conditions.
* Adding medication to the patient was also done by Ashwini.

Vaishali Lavangu:

* Vaishali reviewed the systems of all the patients and entered the recordings in EHR.
* She also created the referral for the patients and added the follow-up appointments in the patient charts.

Sai Sreya Tummala:

* Sreya is our chief writer/ librarian who crucially developed the case studies for all the patients based on the conditions assigned by the remining teammates.
* She also penned her impressions on the problem statement and contributed significantly for the writing part of the presentation and project summary.

**Tasks:**

* We have navigated through the patient tab to record the medical problem in the issues field, enter vitals and added prescription to auto add to medication list.
* To record the misadventure, we have created a new encounter and then added the misadventure to the issues to formulate a diagnosis.
* ICD-10 codes for this misadventure were added from the issues tab by navigating through the list provided in it.
* The patient’s systems were reviewed under clinical field of the encounter tab.
* Later we have auto added the prescription for the misadventure to the medication list.
* A referral was created with transfer summary under encounter tab to the recommended physician.

Each case study needs to be included with a diagnosis, medication, coding terminology.

The diagnosis was made from the patient’s age and past medical conditions if present.

We looked up for references from Mayo Clinic (online website) to find apt medication to the given condition and dosage requirements.

One of the tasks mentioned to add a misadventure to the patient. So, we looked up for ICD-10 codes in LibreHealth EHR from issues field under patient specific tab. The codes starting with ‘V’ or ‘W’ were chosen to record the diagnosis of misadventures.

Later, we researched the needed medication and dosage needed to treat this misadventure from Mayo Clinic webpage.

**RESULTS**

As a team, we have constructed case studies on four different patients. The diagnosis, misadventure and recommended medication are unique for all the patients. The detailed description of all the case studies is provided in the appendix.

**Problems faced so far:**

* The patient appeared at the emergency department for a misadventure concern, but we were not able to assign emergency visit at the new encounter.
* We were not able to edit the medical problem list once an issue was added.
* The assigned begin date to a medical problem is not being reflected on the ‘Issues’ field.
* In the review of systems, the changed fields were neither being saved to the patient history nor being reflected anywhere in the patient chart.
* We were not able to edit the future appointment tab in relation to date and time of appointment.

**DISCUSSION**

We have conducted a usability evaluation for Librehealth EHR system by constructing four case studies. With this approach, we have explored various fields incorporated in this system to record the patient information. This has equipped us to know the functionalities associated with the EHR system and the challenges tangled around it.

**Future research:**

* We plan on documenting the hardships faced during the recording of patient data to the EHR system. This helps us to add relevant fields and to find solutions.
* Adding of emergency field in the new encounter tab is recommended.
* Scheduling of future appointments is a bit challenging and this needs to be fixed in the future.
* We also plan on adding notes to the review of systems field to readily document any change in the systems which can be reflected in the patient history/issues.
* Thoroughly explore various data fields in LibreHealth EHR to include apt diagnosis and ICD-10 coding to the given condition of the patient.

**Conclusion:**

Entering the patient data and detailing the medical concerns of the patient consumes a lot of time which critically reduces the clinical time of the physician with the patient. This results in physician burn out as well. Many of the EHR experts have pointed out cognitive challenges which results from poor EHR usability. Also, another challenge that poor usability could cause is imperfectly formatted information leading to improper adaption of physicians to technical advances (Patel et al., 2021). Poor usability is also major hurdle in the process of adopting to electronic health care systems from traditional paper-based methods (Khan et al., 2017).

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**APPENDIX**

**Description of Case Study-1:**

A 27- year- old male named Harsha Mohit had visited the clinic with a chief complaint of headache and running nose. General physical examination was performed along with complete blood picture and vitals recorded. Everything seemed to be normal. A provisional diagnosis of sinusitis was made based on the chief complaint and initial examination. To validate this diagnosis and formulate a final diagnosis, an endoscopy was performed which confirmed the provisional diagnosis. Fluticasone propionate nasal spray in the form of suspension was prescribed to the patient with a dosage of 93mcg to be taken through each nostril two times a day (Mayo Clinic, 2021a). After few days, on 7/30/2022, the patient was seen at the emergency clinic reporting motorcycle accident. The patient was presented with bleeding from multiple body sites. On examination, head injury was detected. Basic first aid was performed to the patient to control bleeding. A referral visit is scheduled for the patient to visit the neurologist. Later MRI scan was performed to diagnose the head injury. Results indicated there was no damage and prophylactic medication was prescribed. 10 tablets of carbamazepine 200 mg were given to be taken twice daily for five days (Mayo Clinic, 2021b). An ointment neosporin of 28 grams was prescribed to be applied on injured areas thrice daily (WebMD, n.d.). In order to relieve the mild body aches the patient might experience, acetaminophen of dosage 325mg was prescribed to be taken 3 times a day orally for a week. A follow up appointment was created after 2 weeks. At the follow up, injuries seemed to be healed and the prophylactic medication, carbamazepine was discontinued. Patient is advised to apply the topical ointment and take the acetaminophen when pain is felt.

**Description of Case Study- 2:**

A 31- year- old male named Ram Chandra had visited the clinic for routine physical examination. Complete blood picture, fasting blood glucose and general physical examination was performed. Patient is diagnosed with type-2 diabetes and medication is prescribed. After getting to know about the patient’s disease, physician has prescribed metformin tablet with a dosage of 1000 mg, which must be taken through oral route for two times a day (Mayo Clinic, 2022d). After few days, on 09/01/2019 patient came to the emergency department reporting a fall incident from cliff. Patient presented with immense pain and swelling of left hand. Basic first aid was done, and analgesics prescribed to relieve the pain. A provisional diagnosis of radial fracture was made, and patient referred to orthopaedist. A radiograph / X-ray of the left hand is recommended. Diagnosis of radius fractured was confirmed. Left hand immobilized and advised to take rest for 4 weeks. To relieve the pain, acetaminophen was prescribed to be taken twice daily for 10 days. A follow up appointment was created after 1 month. At the follow up, injury seemed to be healed and the prophylactic medication acetaminophen was discontinued. Patient is advised to take acetaminophen when pain is felt.

**Description of Case Study-3:**

A 71-year- old female named Shakti Sinha came to the medical office with a chief complaint of mild difficulty in breathing. On examination, a provisional diagnosis of asthma was made. Based on chief complaint and history, chest X Ray was prescribed. Salbutamol of 1000mcg is prescribed for the patient to be inhaled four times a day. The patient was appointed for regular follow up. After a few months on 08/04/2022 patient was seen at the emergency department with an accident due malfunction of shotgun. Injury was noticed on right shoulder. Bleeding was moderate with inflammation. Patient was presented with severe pain. First aid was performed to the patient, and she referred to orthopaedic surgeon. X ray was taken and wound debrided. Suturing was done to the patient. Amoxicillin and morphine are prescribed to the patient. Amoxicillin of 500 mg must be taken through oral route for three times a day (Mayo Clinic, 2022a). Morphine of 15mg must be taken to relieve the pain (Mayo Clinic, 2022c). Patient was asked to follow up after 3 weeks. At the follow up, injury seemed to be healed and the prophylactic medication, amoxicillin and morphine were discontinued.

**Description of Case Study -4:**

A 51-year-old female named Deepika Singh visited the hospital with a chief complaint of chest pain. Complete blood picture along with routine physical examination and ECG were performed. A provisional diagnosis of angina pectoris was made. Nitro-glycerine was prescribed to the patient with a dosage of 2.5 mg to be taken through oral route two times a day. The patient was kept on regular follow up for every six months. After few days on 10/05/22 patient was seen at the emergency department as she was in contact with dry ice that resulted in burning of her hand. Basic first aid was performed and patient referred to dermatologist. Topical analgesic-lidocaine was prescribed to relieve pain. Referral to dermatologist to diagnose the burn and was concluded to be first degree burns. Topic lidocaine was prescribed along with pain reliever-ibuprofen. The dosage of lidocaine ointment was 25gm to be applied on the wound four times a day (Mayo Clinic, 2022b). The dosage of ibuprofen is 200mg which has to be taken through oral route two times a day. Regular follow up appointments created for the patient for every 4 weeks for 3 months. At the follow up, the burns seemed to be healed and the prophylactic medications lidocaine and ibuprofen were discontinued gradually.