Standard Healthcare Record for Disease: Cancer

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Abstract

The important aspect of medical research and development is maintaining patient's medical records for diagnosis, and treatment. These records play a very important role in the hospital management system. Nowadays, it is difficult to keep and query the traditional paper based medical records. Consider two doctors A and B who work in hospitals X and Y respectively. Hospitals X and Y have their own unique standard formats for storing medical records. In this case, Dr A may experience difficulty in understanding the report of a patient stored in the database of Hospital Y. Likewise, B would experience the same problem w.r.t Hospital X. This problem gets even worse when a patient's case is to be transferred to an international doctor who may find it difficult to understand a local doctor's report schema. Our project overcomes many of the problems faced in other software due to the lack of security, interoperability, accessibility, data management, and many other issues. It provides an electronic centralized database of patient records in an encrypted format which increases security and provides a user-friendly environment with the help of HL7 format for sharing and ICD-10 for labelling diseases.

1. INTRODUCTION

Cancer in a human body is a result of not normal cells that divide uncontrollably and kills body tissue which leads to death. It's the second commonest cause for death in the world. The World Health Organization (WHO) data says that nearly 1.16 million new cancer cases are being registered each year in India. Within the developed world, one in 3 individuals can have cancer throughout their lifetimes. Thus, maintaining prime quality records of cancer treatment is extremely troublesome. To boost cancer data sharing and also the quality of patient care, we aim to capture all the outcomes of every cancer patient and what details should be contained in each patient's electronic health record (EHR).

The field of medicine faces a problem of the lack of a standardized format for filing and maintaining patient reports. A doctor may also confuse another doctor when referring for a patient's treatment to another doctor by using a common name of the injury/disease the patient is suffering from Also, different hospitals make use of different formats for filing patient reports which can also lead to a delay in the process of diagnosis of a cancer patient who has been transferred from one hospital to another. Thus, our project aims to reduce the gap between medical practitioners and institutions when it comes to standardizing patient reports.

EHR is an associated electronic (digital) assortment of medical information of a patient that's stored on a pc. It is an associate rising technology that maintains the whole medical information of a patient.[1] Additionally, it helps the medical practitioner to grasp the whole medical information of a patient with no hindrance. It includes the patient's records, like medication, laboratory reports, the standing of immunization, allergies, treatment plans, and private statistics. Using EHR, the medical practitioner will read the whole medical information of a patient while not following down the previous study. It can also be a helping hand for them to make recommendations concerning the patient's care.

Electronic Health Record (EHR) service permits a patient to make, manage his/her health information in very centralized storage, from which he/she can retrieve and share the medical information with a lot of efficiency. This paper focuses on building information that stores the medical data of patients in a very standardized format. It'll use the ICD standard for labeling diseases. Another vital feature is the sharing of reports within the HL7 format. We tend to develop a GUI primarily based application that will make use of REST API to store medical records in each on-line and offline database.

2. METHODOLOGY

The paper proposes the EHR systems that enable data exchange among all the heterogeneous systems that can be used within various regional health care networks.

A solution was developed which will manage all the data exchange between various hospital centers. A model of the data that is bound to be exchanged is developed which provides the core of the solution through the following method.

1. Data submission via a (web) form (a manual entry of cancer patient data and its transformation to the schema of the model; acting as a proxy to the web service)
2. Data validation of the data (to ensure that the submitted data of the patient is formally correct and valid) dataset.
3. Data transformation to transform the submitted data from the local to the database schema which will be stored on the server).
4. Data retrieval via a web download form (acting as a proxy to the web service; downloading in HL7 format) and exchanging data with the medical practitioners with scientific name and synonymous common name.

3. COMPONENTS OF EHR

3.1. ICD

International Classification of Diseases (ICD-10) are the universal standard for defining and reporting health conditions. It allows people to think about and pass health related data using a common language.

They are alphanumeric codes utilized by specialists, medical coverage organizations, and health related agencies over the world to represent diagnoses. ICD-10 is assigned to every disease, symptom, and injury. ICD-10 codes are utilized for everything from handling medical coverage cases to following disease epidemics and gathering overall mortality insights.

3.2. HL7

Health Level-7 (HL7) was created by Health Level Seven International, a non-profit organization dedicated to developing standards for the exchange of electronic health care data [9]. Transferring and Sharing of patient's record is done by HL7 messages in various Hospitals. Each HL7 message sends healthcare data about a particular event such as a patient admission more efficiently.

3.2.1. HL7 Messages

A message is the unit of data transferred between information systems [7]. In a sequence, a group of segments is made which defines its purpose.

3.2.2. Segments

Logical grouping of data fields is called as Segment. A message segment can be compulsory or discretionary. These segments can be used for a single time in a message or they might be allowed to rehash. A name is given to each segment. For instance, the following Figure 3 shows the Abstract data type (ADT) message with various segments and its description. With the help of 3 character code, a segment can be recognized.

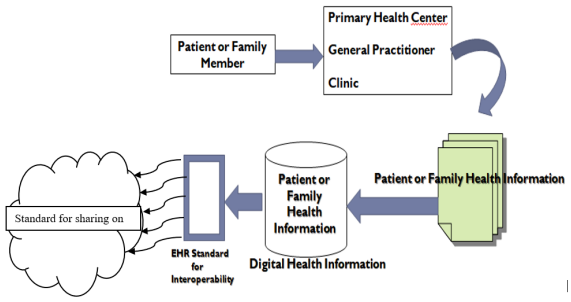

Figure 1: Data Collection and cloud based medical record

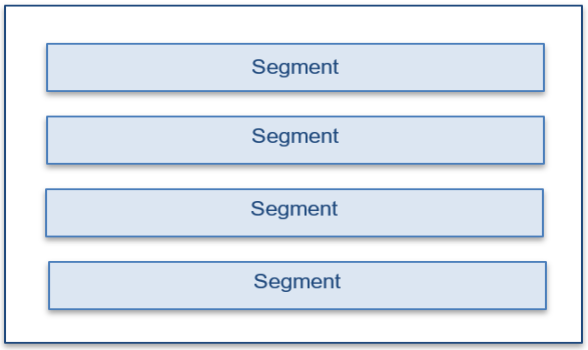

Figure 2: The Message is Break into segments

Table 1: Structure of ICD-10 Code.

Alphabet	*Number or Letter*					
1st Digit	2nd Digit	3rd Digit	4th Digit	5th Digit	6th Digit	7th Digit
C	5	0	5	1	2	
Category of the Disease			Etiology (Cause of Disease), anatomic site (where cancer is growing in body), severity, Laterality (Side of the body on which the reportable tumor originated)			Expansion character for obstetric, injuries and external cause of injury.

Source: "Structure of an ICD-10-CM Code | SEER Training", Training.seer.cancer.gov, 2020. [Online]. Available: https://training.seer.cancer.gov/icd10cm/icd10cm-code-structure.html.

*C50.512: Malignant neoplasm of lower-outer quadrant of left female breast[8].

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3.2.3. Data Fields

For each data field, the information is given below:

- Position - In message segment, sequence or the position of the data field.
- Name - A globally unique field's descriptive name for the field.
- Data type - Contents and specification of the format of the data field is restricted by Data type.
- Id Number - It is the small integer which uniquely identifies the message data field throughout the Standard.
- Maximum Length - In Message, the maximum number of characters that one occurrence of the data field may occupy.
- Optionality - In the message segment, whether the data field is required in a segment or is optional or conditional. The designations are
  R - require O - optional C – Conditional
- Repetition - Whether the data field may or may not repeat. The designations are:
  N - No repetition Y - the field may repeat

3.2.4. Message Delimiters

3.2.5. Example of HL7

4. PROPOSED SYSTEM

Our System proposes a centralized record of diseases accessible with both, scientific name and synonymous common name(s) which is directly mapped and incorporated over a GUI based application to a patient's records and follows an international standard. A developed application would be usable by all medical practitioner and record transmission would also be standardized for international usage. It will make use of the ICD standard for labeling diseases as they are stored in the diseases. An important feature of our project is the sharing of reports in the HL7 format.

Table 2: Description of ICD-10

Length	*3-7 digits*
Character 1	Letter only (all letters except U)
Character 2	Number only
Character 3-7	Numbers or Letter
Decimal	After 3rd Character (not counted)
Letter Format	Case- sensitive

Source: "Structure of an ICD-10-CM Code | SEER Training", Training.seer.cancer.gov, 2020. [Online]. Available: https://training.seer.cancer.gov/icd10cm/icd10cm-code-structure.html.

4.1. Algorithm

For Icd Mapping and Report Formation

1. The list of sub diseases is emptied.
2. Enter the name of the disease that you wish to search for.
3. The ICD code of the disease entered is considered.
4. The ICD code is then checked with the entries of the

SEGMENT	DESCRIPTION
MSH	Message Header
EVN	Event Type
PID	Patient identification
NK1	Next of Kin
OBR	Patient Visit
OBX	Observation Request
ORC	Observation Result
NTE	Common Order
IN1	Insurance
GT1	Guarantor

Figure 3: Message Segments with their description

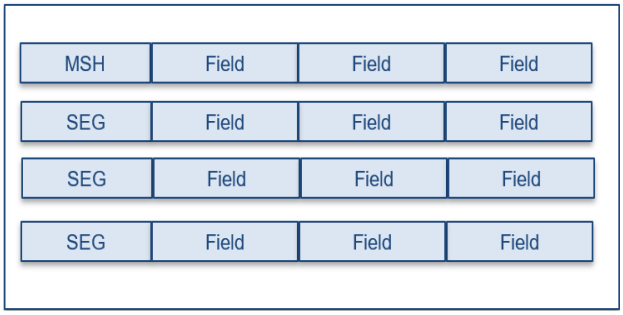

Figure 4: Break the segments into fields

Table 3: Delimiters with their description

Delimiter	*Value*	*Description/Usage*
Field Separator	|	Each segment contains fields that are separated with the light-blue '|' character.
Component Separator	^	Adjacent sub-components of data fields are separated
Subcomponent Separator	&	Where allowed, it Separates adjacent subcomponents of data fields.
Repetition Separator	~	Separates multiple occurrences of a field, where allowed.
Escape Character	\	Escape character for use with any field represented by an ST, TX or FT data type, or for use with the data (fourth) component of the ED data type [7].

MSH|^~\&|||20200215003809||||2.5||||356|English
EVN|ADT|20200215003809|||Admit
PID||||Lalchandani^Rahul^Pratap|Neha|19980826|Male|||356|7719863721^8999559100|||Single|Hindu
OBX|356000000000000102003|1|120|mm of HG|||||'2018-06-12 15:25:22' UTC
OBX|356000000000000102003|2|80|mm of HG|||||'2018-06-12 15:25:22' UTC
OBX|356000000000000102003|3|80|beats per minute|||||'2018-06-12 15:25:22' UTC
OBX|356000000000000102003|4|16|breaths per minute|||||'2018-06-12 15:25:22' UTC
OBX|356000000000000102003|5|170|cm|||||'2018-06-12 15:25:22' UTC
NK1|356000000000002|Lalchandani^Pratap^Satramdas|Father|Ulhasnagar East,
Mumbai|9545455816|0228566993|||Bank
Employee|||PNB|Married|male|19710228|||356|Sindhi|||Hindu|Savitri|356|||||Employed|||123456789101
DG1|356000000000000101|ICD|A01 - A011|||||||||A12345

Figure 5: Example of HL7

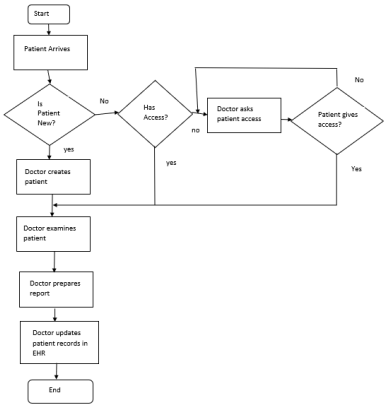

Figure 6: Flow diagram of the system

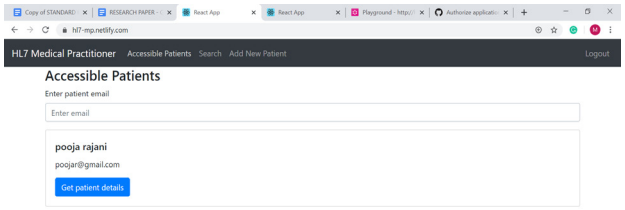

Figure 7: Medical Practitioner home page

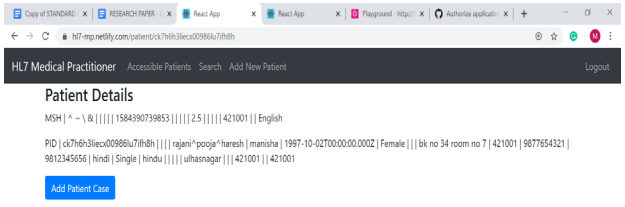

Figure 8: Patient details in HL7 format

icd_sub_codes table for names of specific sub diseases that fall under the category of that specific ICD code.

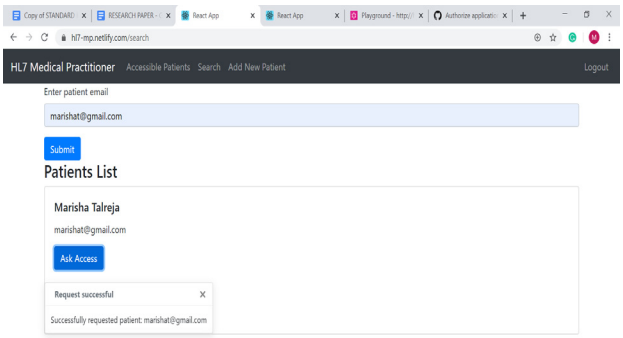

Figure 9: Request access of the Patient

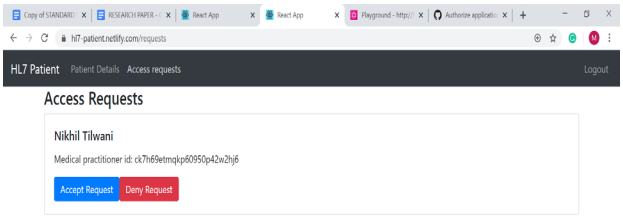

Figure 10: Patient access request page

5. All the entries with foreign key matching that of the ICD codes are collected as a list of tuples.
6. This list of tuples is sent back to the source code.
7. The sub - disease names are arranged properly in the format: 'icd_sub_code - sub_disease_name'.
8. The list is loaded into the dropdown box for the ICD sub codes field.
9. After mapping the local name of disease to standard ICD code the patient report will be generated in the HL7 format (by following the above-mentioned rules) that contain patient demographics and health record i.e. details of patient's case.
10. At last that report will be present at EHR/Server from where a new doctor can ask for request access from a patient for the further treatment process.

4.2. Flow Diagram

Figure 6 shows the workflow diagram of our system. When the patient arrives in the clinic, it is checked whether the patient is registered in the EHR or not. If no, then Doctor creates the patient and examines it and updates its record in EHR. If a patient is registered, the doctor will check

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whether he has access to his records. If no, then he will ask the access of records and examines the patient.

5. RESULTS AND IMPLEMENTATION

The Standard healthcare record is successfully created and deployed with greater security. The implementation of Healthcare Record was done using Graphql-apollo, react js, graphql yoga and node js. React is an efficient JavaScript library which has been used to create a graphical user interface (GUI) of the system. The database for patient's medical information is created in Graphql yoga and node js. Patient's data sharing has been done with the help of HL7 standard with the proper labelling of diseases through ICD-10.

Figure 7 is the screenshot of the medical practitioner homepage. It shows all the accessible patients of the medical practitioner. The buttons to get patient details, ask for patient's access and add new patient records are also provided.

Figure 8 illustrates the UI of the patient details which is in HL7 format. The Medical Practitioner can also add a new record of that patient.

Figure 9 shows the search bar where medical practitioners can search the patient and can ask the request of his/her records.

Figure 10 is the screenshot of the Patient UI. The patient can accept or deny the request of the medical practitioner.

Our model is unique in that it makes use of simple nested functions so that any software debuggers can easily understand and make changes to the code. A custom-algorithm has been created for the same and when compared to other algorithms, it prevails in terms of lesser complexity and easy understandability. Searching is linear in synonym discovery. By giving security rights straight away to patient i.e. new doctors can send the access request to patient data and a patient can allow or deny that request and can easily assure the security of own data. Apart from this patient record(report) can be shared or local download is done with one click. The report is in the HL7 format. Local doctors can share that report by entering the valid email of the international practitioner. The international practitioner will get mail that contains the URL of the report.

6. CONCLUSION

This project provides a secure standard storage system for medical records in the databases. Through the HL7 format, patients' records can be shared everywhere around the world. It uses the ICD-10 standard for labelling diseases. With the help of EHR, proper care of patients is done. It provides correct, up-to-date, and complete data about patients at the point of care. Privacy and Security of patient data are taken care.

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