

## WHO ICD-10 BASED ONLINE DISEASE DIAGNOSIS FOR GENERATING DIGITAL MEDICAL RECORD APPLICATION DEVELOPMENT

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### Abstract

Medical Record is a medical document that contain history of patient's disease also information about given treatments and medicines. Diagnosis of patient's disease is one of content in Medical Record. Public health office recommends medical facility to write diagnosis into ICD-10 WHO standard. However, there are many of medical facility translate diagnosis into ICD-10 WHO standard manually. This manual way will make a lot of mistake or wrong translate result. This research will develop an online application to help the doctor to write patient's disease diagnosis into ICD-10 WHO automatically. Doctors need to type the keyword of diagnosis name then selected diagnosis will automatically write into ICD-10 WHO standard. This application also can generate Digital Medical Record that can help medical facility to reopen or save Medical Record Data in a long time.

**Keywords:** online application disease diagnosis, ICD-10 WHO based diagnosis, digital medical record

### Abstrak

Rekam medis pasien merupakan dokumen medis yang berisi informasi riwayat penyakit pasien serta penanganan-nya oleh fasilitas Kesehatan. Salah satu isi dari rekam medis yakni Diagnosis Penyakit pasien. Dinas Kesehatan menyarankan agar penulisan diagnosis penyakit pasien ditulis sesuai standar ICD-10 WHO. Namun masih banyak fasilitas kesehatan yang menuliskannya secara manual dengan menyalin satu per satu diagnosis penyakit pasien ke dalam standar ICD-10 WHO. Cara ini tentu akan menghasilkan banyak kesalahan penyalinan. Penelitian ini bertujuan untuk membantu tenaga medis dalam menulis diagnosis penyakit pasien ke dalam standar ICD-10 WHO secara digital sehingga meminimalisir kesalahan penyalinan diagnosis. Aplikasi ini akan otomatis menuliskan diagnosis penyakit pasien ke dalam standar ICD-10 WHO. Tenaga medis hanya perlu mencari nama diagnosis nya dengan sebuah kata kunci, kemudian diagnosis yang dipilih akan otomatis mengandung sebuah kode ICD-10 WHO. Aplikasi ini juga menghasilkan rekam medis digital, sehingga ini tentu akan sangat memudahkan fasilitas kesehatan dalam melakukan penyimpanan data rekam medis pasien.

**Kata Kunci:** aplikasi diagnosis penyakit online, diagnosis berbasis ICD-10 WHO, rekam medis digital

### 1. INTRODUCTION

Medical records are important in the world of health. A good medical record reflects good

health services as well. Medical records consist of records of patient data carried out in health services. These records are very important for

services for patients because complete data can provide information in determining decisions regarding treatment, treatment, medical actions and others [1]. One of the most important contents of a medical record is the patient's disease diagnosis section. The Health Service recommends that the patient's disease diagnosis is written in accordance with the WHO ICD-10 standard. ICD-10 is the 10th revision of the International Statistical Classification of Diseases and Related Health Problems. ICD-10 contains coding performed by the World Health Organization (WHO) for diseases, symptoms, abnormal findings, and complaints that cause disease.

There are still many Health Service Facilities that record medical records manually. This certainly affects the accuracy of the results of coding the patient's disease diagnosis. Human error factors such as illegible writing, or unclear abbreviations will greatly affect the accuracy and completeness of the medical records made.

Therefore, an appropriate solution is needed to overcome these problems. Digital recording of medical records is certainly an option that can be considered. The Medical Information System will greatly assist Health Service Facilities in digitally recording patient medical records. With the Information System, it is also possible to perform Machine Learning on the inputted disease data so that later it will be able to provide suggestions for coding the patient's disease diagnosis according to the ICD-10 guidelines.

Problems in the process of making patient medical records manually that continue to occur in health services in Bali, this research is directed to:

1. Provide solutions for health workers to be able to serve patients according to WHO standards.
2. Develop an online application that is able to manage patient medical records, so that a person's medical history becomes clear, and can be used by interested parties quickly and comprehensively.
3. Incorporating machine learning methods to provide diagnostic recommendations in accordance with ICD-10 based on symptoms of the disease experienced by patients to doctors or paramedics.

## **2. RESEARCH METHOD**

### **2.1 Related Research**

Various studies that justify the importance of this proposed research are summarized in [2], designing an Android-based Computer Assisted Coding ICD-10 system. This system helps medical personnel to look up the code on the ICD-10 for the diagnosis of certain diseases. This research was conducted at RSUP Dr. M. Djamil Padang. The result of this research is that the Computer Assisted Coding ICD-10 system is able to provide convenience for officers in finding the correct ICD-10 code.

Aries Muslim conducted a study to create a Health Information System application [3]. This application can provide ICD-10 code suggestions from a disease diagnosis with the anamnesis data that has been inputted. Suggestion ICD-10 code is given by matching the anamnesis data and ICD-10 code that has been inputted in the previous examination.

### **2.2 Health Service Facilities**

Health facilities are places that provide health care. They include hospitals, clinics, outpatient care centers, and specialized care centers, such as birthing centers and psychiatric care centers. The concept of health services is an activity or benefit that one party offers to another. Service is intangible and does not result in ownership of something, but service has a concept [4].

### **2.3 Medical Records**

According to the Regulation of the Minister of Health Number 749a/Menkes/Per/XII/1989, medical records are files containing notes and documents regarding patient identity, examination, treatment, actions and other services provided to patients by health care facilities [1].

According to the Regulation of the Minister of Health Number 269/MENKES/PER/III/2008, medical records are files containing records and documents, including patient identity, examination results, treatment that has been given, as well as other actions and services that have been provided to patients. Notes are writings made by doctors or dentists regarding

actions taken to patients in the context of health services [1].

Medical Records can be in the form of manual (handwritten) medical records and in electronic form with separate provisions. Medical records consist of records of patient data carried out in health services. These records are very important for services for patients because complete data can provide information in determining decisions regarding treatment, treatment, medical actions and others.

#### **2.4 ICD-10**

ICD-10 means the tenth revision of The International Classification of Disease (ICD). ICD is a system that was created for the accurate tracking of diseases within a population [5].

ICD serves a broad range of uses globally and provides critical knowledge on the extent, causes and consequences of human disease and death worldwide via data that is reported and coded with the ICD.

Clinical terms coded with ICD are the main basis for health recording and statistics on disease in primary, secondary and tertiary care, as well as on cause of death certificates. These data and statistics support payment systems, service planning, administration of quality and safety, and health services research.

#### **2.5 Information Systems**

Information systems (IS) are a combination of information technology and the activities of people who use that technology to support operations and management. In a broad sense, the term information system that is often used refers to the interaction between people, algorithmic processes, data, and useful technology [2].

#### **2.6 Database**

A database is a collection of related data. By data, we mean known facts that can be recorded and that have implicit meaning [6]. Databases and database systems are an essential component of life in modern society: most of us encounter several activities every day that involve some interaction with a database.

For example, if we go to the bank to deposit or withdraw funds, if we make a hotel or airline reservation, if we access a computerized library catalog to search for a bibliographic item, or if we purchase something online—such as a book, toy, or computer—chances are that our activities will involve someone or some computer program accessing a database. Even purchasing items at a supermarket often automatically updates the database that holds the inventory of grocery items.

A database is an organized collection of structured information, or data, typically stored electronically in a computer system. A database is usually controlled by a database management system (DBMS) [7]. Together, the data and the DBMS, along with the applications that are associated with them, are referred to as a database system, often shortened to just database.

To process data in the database we need a language, namely Structured Query Language (SQL). The existence of SQL allows us to retrieve data in the database and then display it or present it [8].

#### **2.7 HTML**

HTML stands for Hyper Text Markup Language and is used to describe the structure of web pages. Various Tags are used in HTML such as "heading", "paragraph", "table", and so on [9].

#### **2.8 PHP**

PHP (Hypertext Preprocessor) is an open source programming language that is very suitable for web development and can be embedded into HTML [10].

#### **2.9 JavaScript**

JavaScript is a programming language that was developed with the aim of making HTML documents displayed in browsers more interactive [11].

#### **2.10 Deep Learning**

Deep Learning is a subset of artificial intelligence and machine learning. Deep learning is the development of a multiple layer neural network to provide precision tasks such as object detection, speech recognition, language translation and others [12].

### 2.11 Decision Support System (DSS)

Decision support system is an information system designed to assist in deciding [13]. In the 1980s Artificial Intelligence (AI) was implemented into DSS to increase the level of accuracy in producing a decision on an information system [14].

### 2.12 Method

This research was conducted in the Bali area, in the Gianyar District Health Service Facility. This research is planned to span from April 2021 to December 2021.

The development of this web-based Medical Information System application uses Research and Development methods (R&D Method). Research and Development Method is one of the most outstanding model designs that was designed by Borg & Gall in 1983 [15].

The research procedure consists of five stages, including: analysis, design, development, implementation, and evaluation.

#### 1. Analysis Stage

At this stage, the author conducts a needs analysis if you want to create a digital medical record. What data must be entered if you want to display a good and complete medical record. Analysis of the way medical officers encode disease diagnoses into the ICD-10 code. Interviews with several medical personnel at the Kenak Medika Clinic Ubud will be conducted to obtain the information needed in designing this Medical Information System application.

#### 2. Design Stage

At this stage the author will design a Medical Information System application by going through several stages, including: 1) making storyboards, 2) creating database tables, and 3) designing master data.

#### 3. Development Stage

At this stage the author will develop this Medical Information System application according to the needs analysis and based on the storyboard that has been made. The resulting Medical Information System application can later be run using a web browser on a computer with an option with an internet connection or without an internet connection.

#### 4. Implementation Phase

The designed Medical Information System application will later be tested at the Kenak Medika Ubud Clinic.

#### 5. Evaluation Stage

The evaluation used is a formative evaluation, namely the validation process carried out by the medical record officer at the Kenak Medika Ubud Clinic. The results can be in the form of comments and input that can be used as a basis for analyzing and revising this created Medical Information System application.

## 3. RESULT AND DISCUSSION

In general, an application is always divided into three main parts, namely: 1) the front display or Front-End, 2) the process part or often called the Back-End, 3) the liaison between the Front-End and Back-End which is often called Application Programming Interfaces (APIs).

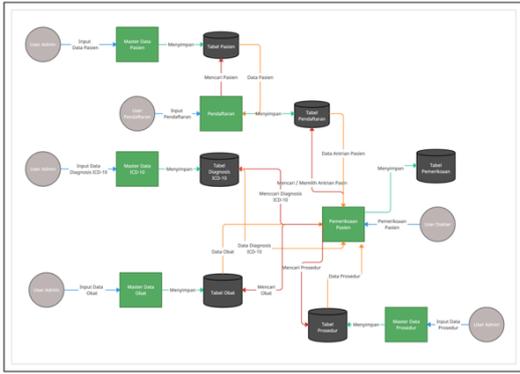
The Front-End Section on the ICD-10-Based Online Disease Diagnosis Application that is currently being developed uses the Cascading Style Sheets (CSS) programming language combined with the JavaScript programming language. The combination of the two programming languages mentioned above will create a very beautiful and responsive User Interface (UI).

Meanwhile, the Back-End section uses the Hypertext Preprocessor (PHP) programming language and the Structured Query Language (SQL) programming language. PHP is used to process data that is inputted to the IU, while SQL is used to store data into a database or database.

Finally, the API section uses the JavaScript language. JavaScript is used to request or withdraw input data on the UI and validate the input data before it is processed by PHP and SQL in the Back-End section.

### 3.1 WHO ICD-10 Based Online Disease Diagnosis Application Architecture

The architecture of the WHO ICD-10-Based Online Disease Diagnosis Application is shown in Figure 1 below.



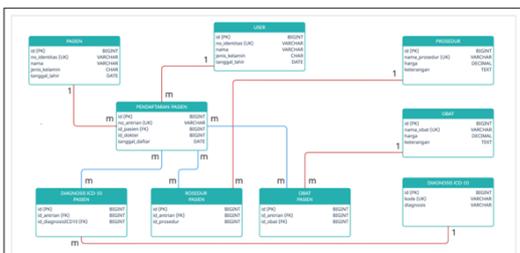
Picture 1. Application Architecture

The first main master data is the patient master data. The patient data master holds all the information about the patient who will perform the examination. Then the second is the ICD-10 master data containing diagnostic data that is in accordance with the CD10-WHO standard. The third main master data is the drug and procedure master data, where this master data stores a list of drugs and a list of procedures that are usually required in the patient examination process.

The doctor's examination process begins with the creation of a patient registration. Queue - the resulting queue will later be selected by the doctor for examination. During the examination process, the doctor will need ICD-10 diagnostic data, drug data, and procedure data. All these units will later produce an examination result which is often referred to as a medical record.

### 3.2 WHO ICD-10 Based Online Disease Application Database Scheme

The database schema in the WHO ICD-10-Based Online Disease Diagnosis application is shown in Figure 2 below.



Picture 2. Database Schema

### 3.3 Diagnostic Search Algorithm

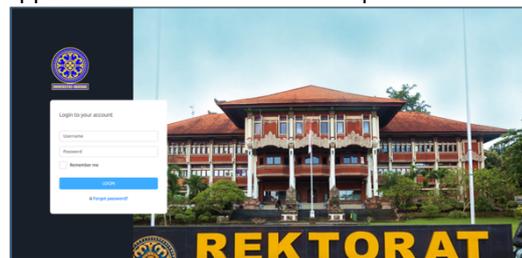
The diagnosis search algorithm used in the WHO ICD-10-Based Online Disease Diagnosis application is as follows:

1. The keywords entered by the doctor will be trimmed first, this is to remove the whitespace contained in the keywords.
2. Perform SQL MATCH on the ICD-10 diagnosis table with the first step processing keywords. This MATCH process will produce an accuracy score.
3. Displays ICD-10 diagnostic data based on the accuracy score generated in the second step. The higher the standard accuracy score specified the less list of ICD-10 diagnoses will be displayed. Vice versa.

### 3.4 WHO ICD-10-Based Online Disease Application Prototype Results

This WHO ICD-10-Based Online Disease Diagnosis Application starts with a login page as the starting page. Then enter the patient registration feature as the beginning of service. Then go to the doctor's examination feature. In the doctor's examination feature, input for diagnosis, procedures, and drugs received by the patient is carried out. Everything that is inputted by this doctor will become a single unit of information called the patient's medical record.

Picture 3 is a page for logging into the application. Pictures 4 and 5 are pages for inputting, updating, and deleting WHO ICD-10 diagnosis data. Pictures 7, 8 and 9 are a display of digital medical records generated by the application that has been developed.



Picture 3. Login Page

No.	Kode	Sub-Chapter	Kode Sub	Kode Sub Sub	Kode Sub Sub Sub	Terminologi
1	A01					Cholera
2	A02					Cholera due to Vibrio cholerae O1, biotype classical cholera
3	A03					Cholera due to Vibrio cholerae O1, biotype non-classical cholera
4	A04					Cholera non-specific
5	A05					Typhoid and paratyphoid fevers
6	A06					Typhoid fever (cholerae due to Salmonella typhi)
7	A07					Paratyphoid fever A
8	A08					Paratyphoid fever B

Picture 4. WHO ICD-10 Diagnostic List

**Diagnosis Carried Out**

No.	Diagnosis	ICD-10 Code
1	Cholera due to Vibrio cholerae O1, biotype classical cholera	A01001.0

**Treatment Carried Out**

No.	Treatment	Qty	Rate
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**Medicines & Disposables Carried Out**

No.	Medicine	Qty	Price	Rate
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**Recommendation**

1. Lakukan observasi lebih lanjut, komunikasi aktif dengan keluarga, dan di monitor dengan ketat terhadap perubahan keadaan klinis. Segera lakukan rujukan ke rumah sakit jika diperlukan. Segera lakukan rujukan ke rumah sakit jika diperlukan. Segera lakukan rujukan ke rumah sakit jika diperlukan.

Picture 9. Medical Record Final Part

**Master Data ICD-10**

Search and selection interface for WHO ICD-10 diagnostic data.

Picture 5. Form To Input WHO ICD-10 Diagnostic Data

**Search Diagnoses**

Search and selection interface for patient's disease diagnosis.

Picture 6. Form for Finding and Selecting a Patient's Disease Diagnosis

**Patient Information**

Form containing patient information and examination details.

Picture 7. Medical Record Part One

**General Examination**

Form containing general examination and specialist consultation details.

Picture 8. Medical Record Part Two

#### 4. CONCLUSION

Based on the research results obtained, the WHO ICD-10-Based Online Disease Diagnosis application that was developed was able to produce digital patient medical records. Some of the important features of this application include:

##### 1. Digitally Stored Diagnostic Data, Procedures, and Drugs

Some data such as name and diagnosis code, procedure name, and drug name are inputted and stored into each database.

##### 2. Patient Data Stored Digitally

Every new patient data entered during the registration process is automatically stored in the patient database. So this will facilitate and speed up the process of queuing polyclinic services if the same patient visits again.

##### 3. Patient Queue Automatically Seen on Doctor

Patients who have been registered at the registration counter will automatically be seen at the clinic with the doctor's funds. This is because there is a link or relationship between the patient queuing system and the doctor's examination system.

##### 4. Diagnosis according to WHO ICD-10 Standard

The patient diagnosis section on the doctor's examination page has been displayed according to the WHO ICD-10 standard.

##### 5. Diagnosis, Procedures, and Drugs are Easy to Find

The process of searching for names and diagnosis codes, procedure names, and drug names is very easy, by typing the name or code and then several lists of diagnoses, procedures, and drugs will be provided according to the keywords typed.

##### 6. Digital Medical Records

All examinations entered by the doctor are recorded digitally which can then be accessed again in the form of a Digital Medical Record.

This application produces a medical record with the attachment of a Disease Diagnosis according to the WHO ICD-10 standard. This standardized medical record will help several related parties such as the Health Office or the Ministry of Health.

This application is also able to display Medical Records appropriately according to the patient in question. This means that it will not be possible for medical records to be exchanged between patients. This is because this application is highly integrated between one menu and another.

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