

## Design a Program to Improve Patient Data Recording According to the Tenth International Classification of Diseases (ICD-10) in the Wasit Health Department/Iraq for 2025

<sup>1</sup>Wria Abbas Al-Arkwze, <sup>2</sup>Mathil Alwan Mansur, <sup>3</sup>Ahmed Mohammed R. Al-Awsi

<sup>1</sup>Department of Statistics, College of Science, Razi University, Kermanshah, Iran.

<sup>2</sup> Ministry of Health, Chief in charge of ICD. 10 program in Alzahraa tech hospital in Alkut. Wasit.

<sup>3</sup> College of Computer Science & Information Technology, Wasit University, Wasit, Iraq

Corresponding author: Iraqweesa@gmail.com

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### Abstract:

Recent advances in electronic technology, the increasing reliance on electronic health records, and the availability of big data analytics software and systems in healthcare have opened the door to precision medicine. Electronic health records are organized collections of patient information, collected and consolidated in real-time and stored digitally. EHRs were originally designed to facilitate the transfer of patient data, support decision-making, and improve the quality of care. This study aims: to apply (EHRs-WHD) Electronic health records software in the Wasit Health Department to record diseases. Program design: An applied program to record data of patients visiting the health institutions. Setting: Consultancy Clinic, Primary Health Care Centre in Kut. Sampling: A convenience sample of two health institutions in Kut. Tools and Measurements: The following materials were used to implement the program (Windows PC, laser printer, barcode reader). Results: This program significantly reduces effort, time, fatigue, and error. If used online, it can also speed up the time it takes to send and receive data, reduce the number of people responsible for entering data, and provide more accurate and comprehensive reports to officials and decision-makers. Conclusion: Apply (EHRs-WHD) Electronic Health Records Software. This will facilitate the Ministry of Health's efforts to gain insights into disease prevalence, regional disparities, and demographic-specific health trends.

**Keywords:** Electronic health records (EHR), codes, disease, ICD-10, WHO

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### Introduction:

ICD-10 (10th edition) is the statistical classification of relevant diseases and health problems according to common characteristics.[1] In this classification, the World Health Organization (WHO) defines unique codes for every class to compare worldwide diagnoses, side effects, and causes of death by infectious diseases, disorders, injuries, and other causes. These codes are a very important tool for processing, comparing, and classifying statistical information collected by doctors, medical organizations, insurance companies, and other entities worldwide.[2] Hence, over 117 countries are currently using ICD-10 to report causes of death and to classify and analyze health medical data, this method has become a powerful instrument for this purpose.[3] [4]Using these codes instead of long

characters and words accelerates and eases data recovery and analysis.[5] Nowadays, the validity and integrity of such data should be investigated above all else. And doctors need to realize the importance of quality health records in providing correct health statistics.[6] Due to the large volume of information in the ICD-10 system, using a database is the best method to store the information related to statistical classification data. A database is a set of relevant and organized information that represents a fast, secure, and optimal method for saving and recovering data types all over the world, including statistical information. Nowadays, many developed countries use databases to store health and medical information since this method can safely and easily exchange a great deal of information between healthcare centers.[7] According to the instructions of the Iraqi Ministry of Health, the Wasit Health Department relies on Microsoft Excel to collect and consolidate patient data from relevant health institutions according to the tenth international classification of diseases, then enter the data again after unifying it in the patients' program and send it to the ministry. This process requires many employees and takes a long time to enter data. Some data is deleted or lost during these stages. The adoption of EHRs has been in place for over 30 years.[8] Recent advances in electronic technology, the increasing reliance on electronic health records, and the availability of big data analytics software and systems in healthcare have opened the door to precision medicine. Electronic health records are organized collections of patient information, collected and consolidated in real-time and stored digitally. EHRs were originally designed to facilitate the transfer of patient data, support decision-making, and improve the quality of care.[9] This program can significantly reduce effort, time, fatigue, and error. If used online, it can also speed up the time it takes to send and receive data, reduce the number of people responsible for entering data, and provide more accurate and comprehensive reports to officials and decision-makers. To facilitate the Ministry of Health's efforts to gain insights into disease prevalence, regional disparities, and demographic-specific health trends. This study aims to apply (EHRs-WHD) Electronic health records software in the Wasit Health Department to record diseases.

### **Theoretical Framework:**

### **Methodology:**

Increasing staffing challenges; cumbersome data collection; and uncertainty about the generalizability of these data are driving up costs and are thought to contribute to underinvestment in this area.[10] Automatic ICD-10 coding is important because manually assigning codes is expensive, time-consuming, and error-prone. Although numerous approaches have been developed to explore automatic coding, few have been applied. We aim to construct a practical, automatic ICD-10 coding machine to improve coding efficiency and quality in daily work.[11] Improvement in recording the data would benefit the adoption of EHR systems and promote change in how to record patient information.[8]

### **Program design:**

An applied program to record data of patients visiting the health institutions.

### **Setting:**

Consultancy Clinic, Primary Health Care Centre in Kut.

### **Sampling:**

A convenience sample of two health institutions in Kut.

### **Tools and Measurements:**

The following materials were used to implement the program (Windows PC, laser printer, barcode reader).

### **Program components:**

Data entry windows

Output windows

Control windows

### **Application framework:**

#### **Building The Program:**

The application was built using multiple tools to achieve scalable, dependable software. These tools include SQL Server, Visual Studio, and frameworks such as .NET WPF, which contribute a lot to allowing the construction of a well-designed and modern user-interface (UI).

### **Tools:**

To give a fundamental idea about the tools used, they're to be briefly covered below:

**SQL Server:** SQL Server 2022 is a Microsoft-developed relational database management system that uses Structured Query Language (SQL) to manage data stored in tables, ensuring data integrity and reliability through transaction support and security features, while also providing tools for advanced data analytics and business intelligence. It was used because of its native operation on Windows, which is a very popular and widely adopted operating system.[12]

**Visual Studio IDE:** Visual Studio 2022 Community, also developed by Microsoft, is an integrated development environment (IDE) that provides a comprehensive suite of tools for writing, debugging, and deploying software applications across various platforms. Like SQL Server, it works natively on Windows and is tightly integrated with SQL Server.[13]

**Windows Presentation Foundation (WPF):** Bundled with Visual Studio, is a framework that enables creating visually rich and interactive desktop applications on Windows by providing a unified model to render user interfaces, handle data binding, and integrate multimedia content.[14]

**Crystal Reports:** Crystal Reports is a business intelligence reporting tool that enables the design, generation and distribution of interactive, data-driven reports from a variety of data sources, offering robust formatting, visualization, and export features to support enterprise data analysis and decision-making.[15]

### **Building Software:**

1. **Installation and setup:** Preparing the environment that is to be used for development is the initial step; we start by downloading each of the necessary tools and programs. A comprehensive

guide to do this is given on the installation page of each tool's website.

2. **Creating the database:** After installing SQL Server and SQL Server Management Studio (SSMS), we can open SSMS and login to the automatically created SQL Server (which was created during installation). After so we would need to create tables for the following:

- (a) Software users, including credentials and permissions.
- (b) ICD10 List of diseases (Codes and Names)
  - i. This also should include constraints for the software to avoid human error, such as limiting a disease to a certain age, gender, etc.
- (c) List of the institutions responsible for inserting patient information.
- (d) List of patients that have visited the health center; this gets split into
  - i. Diagnosed Cases
  - ii. Undiagnosed Cases (Waiting Diagnosis).
- (e) Logs and their complementary record tables.

3. **Creating a project:** Next, we can utilize the .NET Desktop Development bundle with Visual Studio to create a New Project using WPF .NET, let's assume that the name of our project is "EHRs-WHD" and it would contain the following.

- (a) **Connection Class:** Used to hold the program's connection string to the database and other connection related functions.
- (b) **Utilities Class:** This class holds the common functionalities that are to be used during the development of the software, it helps reduce clutter and repetition throughout the code.
- (c) **Login Window:**
  - i. **Login XAML:** Contains the design of the window, including the username and password fields as shown in the pictures below.
  - ii. **Login Class:** Contains logic that controls the design and what the window shows.
- (d) **Main Window:** This is the starting point of the user, from this window, the user can navigate through the functionalities of the application such as viewing the cases that were diagnosed, manage user information, etc.
- (e) **Add Case:** This window is used to fill in the information of a new case, which is when a patient arrives and get registered into the application. In this stage, the basic information of the patient is filled which will then determine which disease can be assigned to the patient's record in the software, as this is affected by info such as gender and age. This window also doubles as an Edit Case Window. This pattern was used throughout the software in general to promote reusability, maintainability and cut on time and effort required to modify or update certain functionalities of the software when needed.

(f) **Case Management Windows:** These windows include the Diagnosed Cases and Pending Diagnoses, together they form a big part of the software's core. Through these windows the user may view and search the cases using specific and detailed filters, they may also use a QR Reader which will - upon reading the QR Code of the patient's receipt - automatically instruct the software to open the relevant case's information, allowing the user to easily fill in the diagnosis information or make any necessary modifications. In addition to generating reports based on the filters chosen and more.

(g) **Diseases Management:** Through these windows, the user is able to add, edit, delete and view all the diseases in the software.

(h) **Institutions Management:** This set of windows enable the user to add, edit, delete and view the institutions in the software.

(i) **User Management:** Through this part, allowed users can create/modify/remove user accounts of the software.

4. **Encryption:** Safety is a crucial part of every software. It is necessary to protect the privacy of the users and patients and ensure that the software is safe from being tampered with or accessed by unauthorized parties. Modern technologies are used to guarantee this, from obfuscation and reverse engineering prevention methods, to data security and encryption (i. e. using asymmetric methods)

5. **Linking Components:** We repeat the process of creating UI components and backend functionality for any other features required. Then its a process of linking each component with its relevant ones, such as redirecting the user to the edit information window of a case upon clicking the edit button from the cases view window, etc.

Through these steps, the software can be built with scalability and adaptability in mind, allowing for future changes or modifications whether they were for improvement purposes, adding new features, removing redundant features or changes that happen due to organizational rules etc. For example, the SQL Server maybe hosted and managed at a top level organization such as the Ministry of Health, that organization would be able to overview the work of related institutes working under its directory such as health centers, hospitals etc. This form of distribution of roles guarantees a well-controlled operation of the software to fulfill the goals it was created for without any distractions.

## Login Window

The login window consists of two textboxes and a button: one text box for the username, another for the password, and the button to trigger the login event.



The image shows a login window for the 'Medical Statistics System'. At the top center is a green house icon with a white plus sign. Below the icon is the text 'Medical Statistics System'. Underneath are two input fields: 'Username' and 'Password'. At the bottom center is a dark blue button with the text 'Login'.

**Figure (1) – Login Window**

### Main Window

The main window is the starting point for anything the user wants to record. Such as Add New Case, Pending Diagnosis, and Diagnosed Cases.

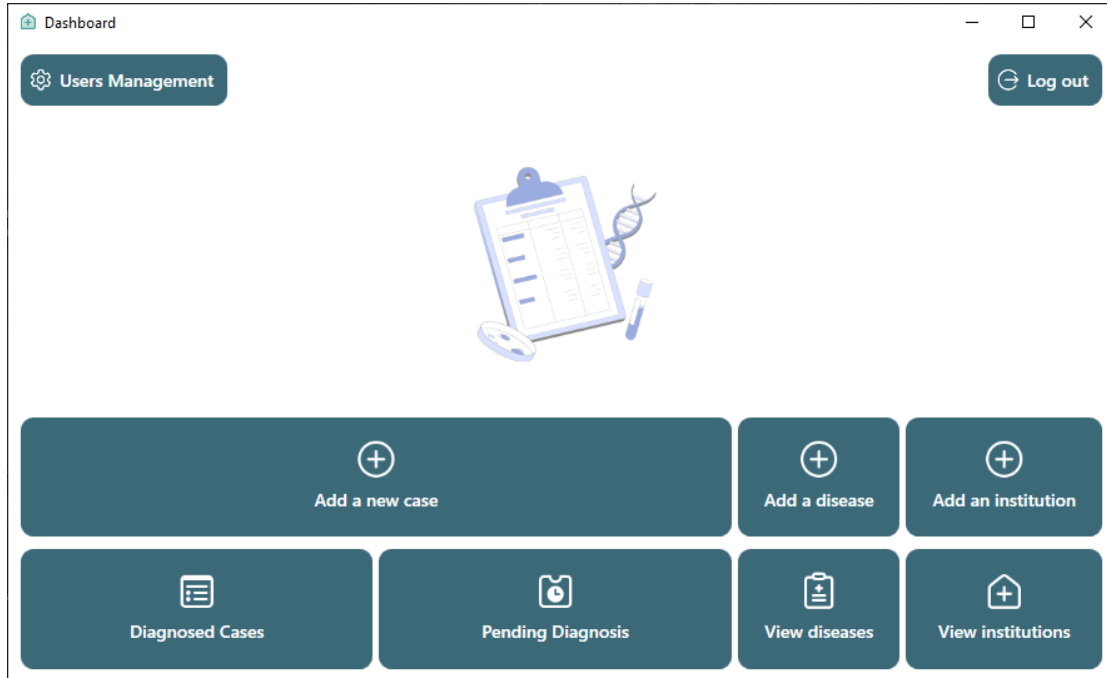


Figure (2) – Main Window

### 1.Add New Case Window

This window is used to enter patient data such as name, age, and gender.

The image shows a window titled "Add Case" with a standard window control bar (minimize, maximize, close). The form contains the following fields: "Name" (text input), "Age" (two text inputs for "years" and "months" separated by "years and months"), "Gender" (dropdown menu), "Date" (text input with a calendar icon showing "15"), "Disease Code" (dropdown menu), and "Disease Name" (dropdown menu). At the bottom of the form is a dark teal button labeled "Add".

Figure (3) – Add New Case Window

## 2. Add New Disease Window

This window is used to add a new disease to the list of diseases in the program.

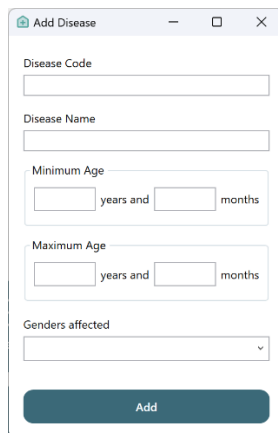


Figure (4) – Add New Disease Window

## 3. Add New Institution Window

This window is used to add a new institution to the list of institutions in the program.

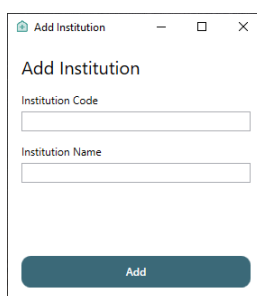


Figure (5) – Add New Institution Window

## 4. Diagnosed Cases Window

This window is used to view all the diagnosed cases.

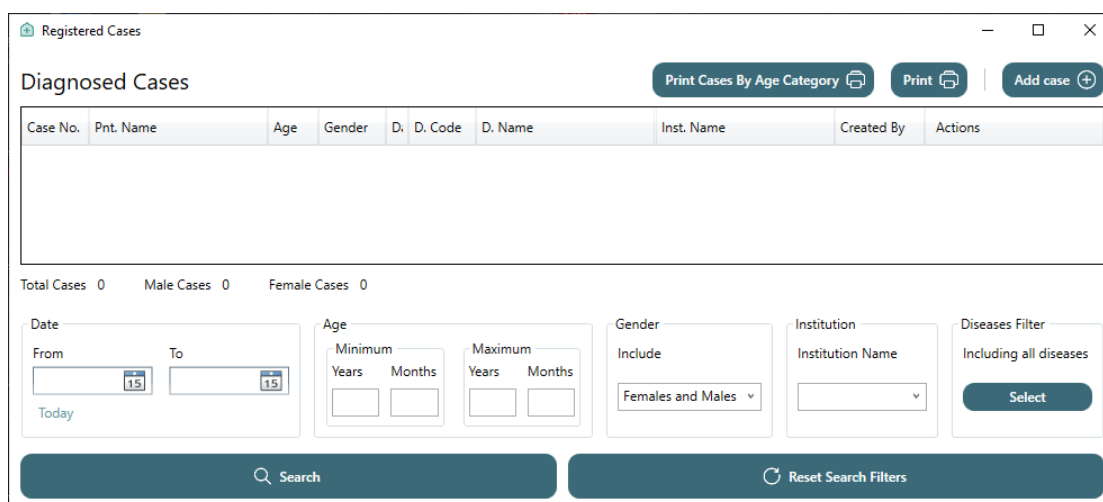


Figure (6) – Diagnosed Cases Window

### 5. Pending Diagnosis Cases Window

This window is used to view cases that have not yet been diagnosed.

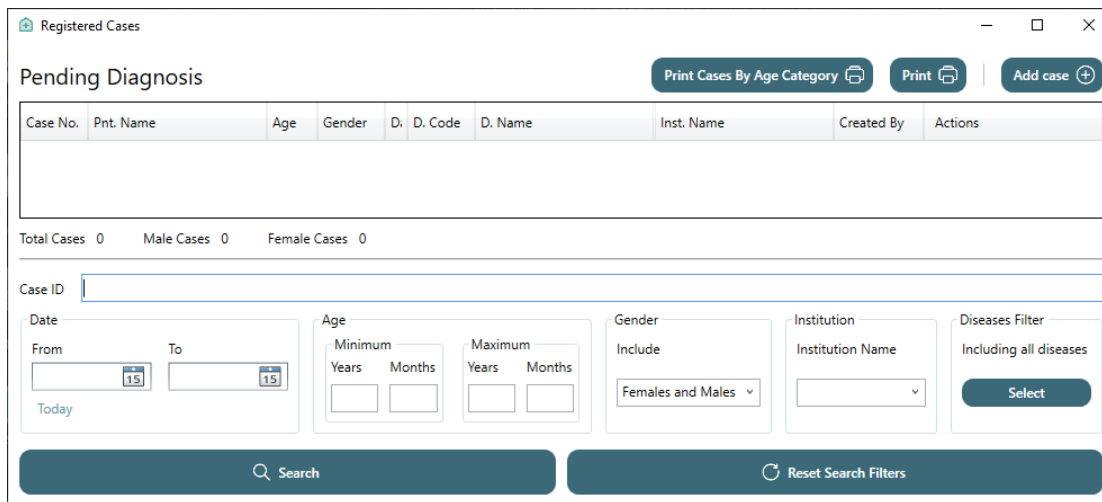


Figure (7) – Pending Diagnosis Cases Window

### 6. Diseases List Window

This window shows all the diseases saved in the program.

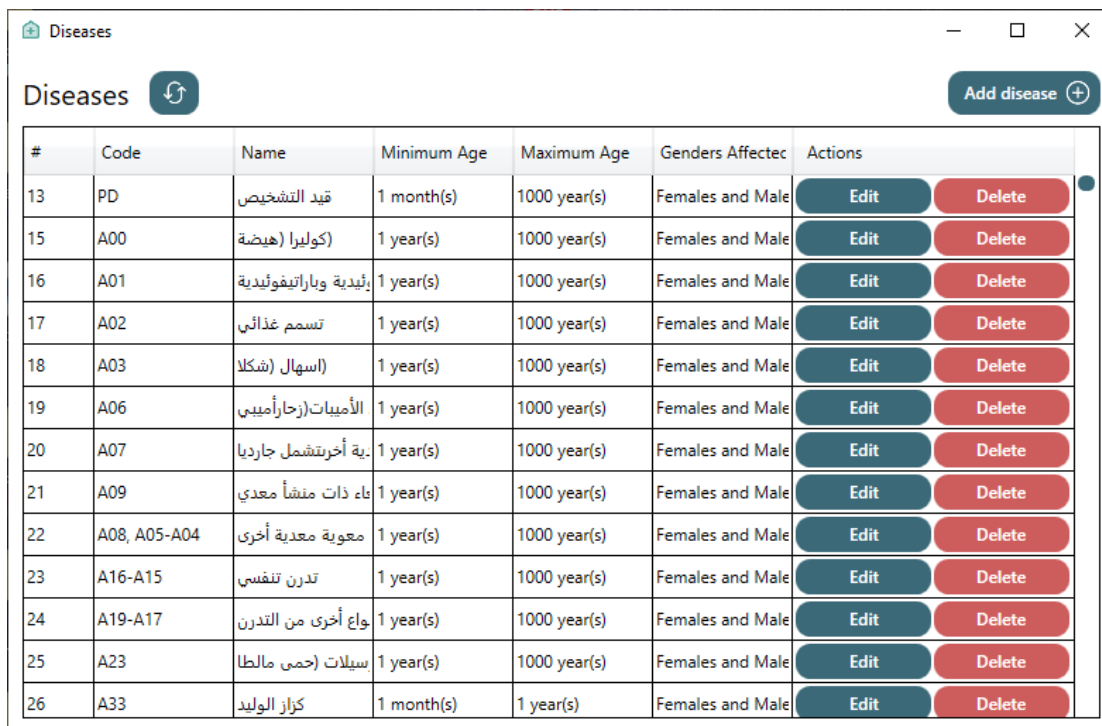


Figure (8) – Diseases List Window

### 7. Institutions List Window

This window shows all the institutions saved in the program.

Institutions Window		
Institutions		Add institution +
Code	Name	Actions
001	مستشفى الزهراء	Edit Delete
002	مستشفى النعمانية	Edit Delete
003	مستشفى الشهيد فيروز	Edit Delete
004	مستشفى الكرامة	Edit Delete
005	مستشفى الصويرة	Edit Delete
006	مستشفى العزيزية	Edit Delete
015	مستشفى الحاج جلال للولادة	Edit Delete
017	مستشفى الكوت للتسليية والاطفال	Edit Delete
040	الهلل الاحمر الاهلية	Edit Delete
C005	قطاع العزيزية للرعاية الصحية الاولى	Edit Delete
C01	قطاع الكوت الشطر الاول للرعاية الصحية الاولى	Edit Delete
C02	قطاع الكوت الشطر الثاني للرعاية الصحية الاولى	Edit Delete
C03	قطاع الحي للرعاية الصحية الاولى	Edit Delete

Figure (9) – Institutions List Window

### Electronic Ticket

The image shows the printed electronic ticket for the patient. Inside the ticket is the Patient data and a QR code to call up the patient’s data in the program quickly and easily through any QR reader to complete the diagnosis addition process.

Institution Code

Case No.

Date

Patient Name

Gender  Age

Code  Diagnosis

QR Code




Figure (10) – Electronic Ticket Window

### Cases By Age and Gender Report

The image shows the Reports by age group and gender.

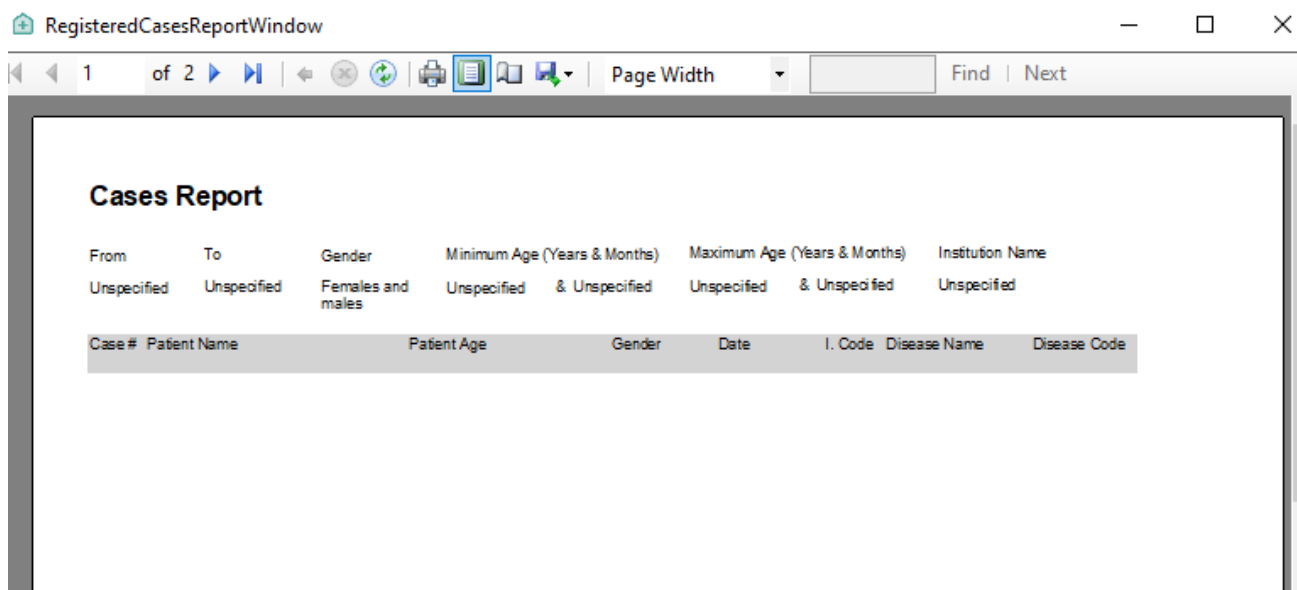
### Cases By Age & Gender Report

Age Category	Males	Females	Total
Less than a year	0	0	0
One to four	0	0	0
Five to nine	0	0	0
Ten to fourteen	0	0	0
Fifteen to nineteen	0	0	0
Twenty to forty four	0	0	0
Forty five to sixty four	0	0	0
Above sixty five	0	0	0
<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>

**Figure (11) – Age group and Gender Report Window**

### Registered Cases Report

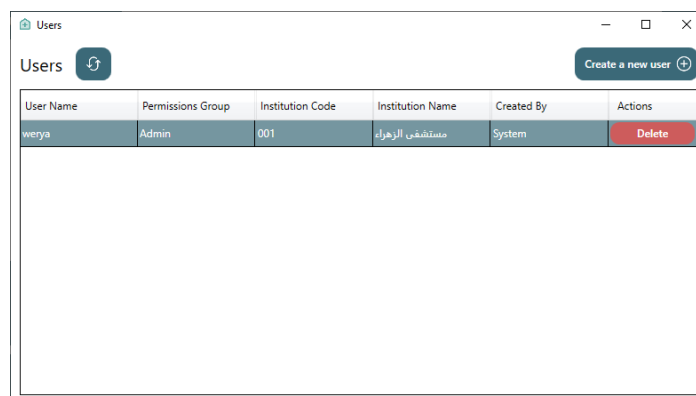
The image shows the Reports including all the registered cases (diagnosed or pending diagnosis).



**Figure (12) – Registered Cases Report Window**

### Users Management Window

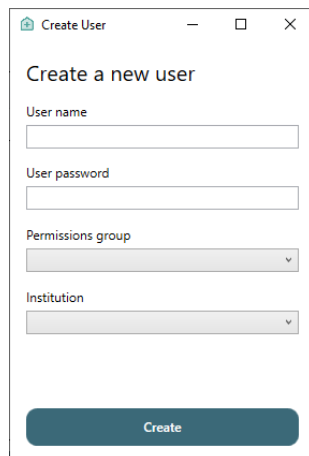
This window shows where the program administrator can view all users registered in the system, create new ones, set permissions, and delete users.



**Figure (13) – Users Management Window**

### User Creation Window

This window shows where the program administrator can create a new user and specify their permissions group (Admin, Normal user) or set the institution they belong to.



**Figure (14) – User Creation Window**

### Reference:

- [1] B. T. Crabb, BS, A. Lyons, and M. Bale, “Comparison of International Classification of Diseases and Related Health Problems, Tenth Revision Codes With Electronic Medical Records Among Patients With Symptoms of Coronavirus Disease 2019,” *JAMA Netw Open*, vol. 3, no. 8, 2020, doi: 10.1001/jamanetworkopen.2020.17703.
- [2] A. Storesund *et al.*, “Accuracy of surgical complication rate estimation using ICD-10 codes,” *British Journal of Surgery*, vol. 106, no. 3, pp. 236–244, 2019, doi: 10.1002/bjs.10985.
- [3] W. P. MD, M. Yuenyongsuwan, Y. Yokobori, H. Endo, and S. K. PhD, “Development of the ICD-10 simplified version and field test,” *British Journal of Surgery*, vol. 47, no. 2, 2017, doi: 10.1177/1833358317701277.
- [4] R. Jakob, *Disease Classification*, vol. 2. 2017.
- [5] Daoud Mia, *International Statistical Classification of Diseases and Related Health Problems Tenth Revision*, vol. 1. 2003.

- [6] K. Burles, G. Innes, K. Senior, E. Lang, and A. McRae, "Limitations of pulmonary embolism ICD-10 codes in emergency department administrative data: let the buyer beware," *Medical Research Methodology*, vol. 17, no. 89, 2017, doi: 10.1186/s12874-017-0361-1.
- [7] K. Ary Budi Permana, G. Brahupadhya Subiksa, and M. Sudarma, "Design Data Warehouse For Centralized Medical Record," *International Journal of Engineering and Emerging Technology*, vol. 2, no. 2, 2017.
- [8] A. Fahem Neamah and M. Khanapi Abd Ghani, "Adoption of E-Health Records Management Model in Health Sector of Iraq," *Indian Journal of Science and Technology*, vol. 11, no. 30, 2018, doi: 10.17485/ijst/2018/v11i30/128724.
- [9] S. Lee *et al.*, "Electronic Medical Record–Based Case Phenotyping for the Charlson Conditions: Scoping Review," *JMIR Med Inform*, vol. 9, no. 2, 2020, doi: 10.2196/23934.
- [10] M. R. Cowie *et al.*, "Electronic health records to facilitate clinical research," *Clin Res Cardiol*, vol. 106, pp. 1–9, 2017, doi: 10.1007/s00392-016-1025-6.
- [11] L. Zhou, C. Cheng, D. Ou, and H. Huang, "Construction of a semi-automatic ICD-10 coding system," *BMC Medical Informatics and Decision Making*, vol. 20, no. 67, 2020, doi: 10.1186/s12911-020-1085-4.
- [12] "SQL Server technical documentation." [Online]. Available: <https://learn.microsoft.com/en-us/sql/sql-server/?view=sql-server-ver16>
- [13] "GitHub Copilot Free in Visual Studio." [Online]. Available: <https://visualstudio.microsoft.com/>
- [14] "Windows Presentation Foundation documentation." [Online]. Available: <https://learn.microsoft.com/en-us/dotnet/desktop/wpf/?view=netdesktop-9.0>
- [15] "SAP Crystal Reports." [Online]. Available: <https://www.sap.com/products/technology-platform/crystal-reports.html>