Original Article

The Department of Health Diabetes Mellitus Health Information Technology Database in Malta
A Basis for a Maltese Diabetes National Register

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Abstract

Government Diabetes clinics in Malta share a Web based computerised system that offers a user friendly Windows based approach to day to day diabetes care. The system can also produce research related data and administrative reports to help local health care providers identify problems and implement programs to improve standards of diabetes care. The database can be used as the basis for a National Maltese Diabetes Register.

The system has a dataset shared with the European Union DG-SANCO EUBIROD System. EUBIROD can create comparative reports on data aggregated from various centres across Europe.

This paper describes the function of the system and its evolution over a number of years. Some pending issues are discussed

Keywords

Malta, Diabetes Mellitus, Health Information Technology, Database, Web based

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Introduction

The medical record is crucial for proper clinical management; besides providing evidence of patient care it is also an important legal document. Traditionally, doctors have used paper records to keep patient data. The digital age brought with it the Electronic Health Record.

The benefits of Electronic Health Records (EHRs) over paper records include immediate access to authorized personnel of uniformly legible data, no physical storage space requirements and reduction in the number of personnel needed for record administration. Other advantages are improved clinical outcomes, optimised operational performance and improved ability to conduct research. The disadvantages of EHRs include installation and maintenance costs and potential patient privacy violations. Overall, however, experts and policymakers believe that significant benefits to patients and society can be realized when EHRs are widely adopted and used in a "meaningful" way.[1]

In this paper we describe the Diabetes Electronic Health Record System being used in the Department of Health in Malta.

Background Information

The use of IT technology in Diabetes in Malta runs back several years. In the 1980's the World Health Organisation (WHO) donated an electronic medical record system called COmputer STored Ambulatory Record (COSTAR).[2] In the late eighties one of the authors (JA), the clinical project coordinator of the system since 1987, thought out and planned a new system that was developed by the then Management Systems Unit with funds donated by the University of Malta, and the Health

Department in Malta; all developments done since then and to date have been according to clinical and layout requirement specifications conceived and requested by JA. The current system has an improved user-friendly interface that should help the process of managing clinic visits. The System has an inbuilt validation facility where validation on certain fields is carried out on input. The administrator has the facility to add maintenance data (e.g. Medications, pre-defined free text, etc.) that are used in the available dropdowns present in the system.

The development and technical description of the system is described in Annex A.

The System

The System offers a Windows Web based approach to day to day diabetes care and is used by the Department of Health Diabetes clinics at Mater Dei Hospital and Health Centres. The records include the History of Visits, Medications, Medical Laboratory Results, Complications and Diabetes Education. The standard format promotes equal care for all patients. The system has data extraction facilities that can generate administrative audit reports and data for research purposes.

As of December 2016 there were 26737 patients registered on the database and 129339 patient visits recorded.

The dataset in the database includes fields shared with the Best Information through Regional Outcomes (B.I.R.O)[3] and EUropean Best Information through Regional Outcomes in Diabetes (EUBIROD) System[4] datasets. B.I.R.O. was a European Union (EU) sponsored project under the Health Information Strand of the Public Health Program (DG-SANCO) that provided European health systems with an evidence and population-based diabetes information system. EUBIROD was another EU sponsored project that produced an open source program that can pool and analyze aggregated data securely transmitted from various diabetes databases. B.I.R.O. and EUBIROD include security and privacy protection mechanisms ensuring compliance with current legislative norms[5]. Malta, through the University of Malta, was a consortium founding member of both B.I.R.O. and EUBIROD.[6]

Using the System

The system can be accessed by navigating to https://diabetes.gov.mt and logging in with the appropriate username and password. Patients can be added or searched for using the ID Card Number, Passport Number, Surname and Name or Patient Initials as filtering criteria.

Data entry and editing is Windows based and spread over 11 forms. Each form has a top panel containing the Name, Surname, Age, ID Card Number, Consultant in charge of patient, Waist, Height, BMI, Years since Diagnosis and Type of Diabetes. Any of the forms can be accessed by pressing the appropriate button from one of a series present on each screen See Figure 1.

Data can be added to or edited by pressing the New Record, the Edit Record or the Close Screen buttons. These three buttons are the only ones needed to manipulate data in the system.

In certain forms, e.g. the Diabetic History and Symptoms forms, only one new record can be added per patient per day. In some other forms, on adding a new record, the entry is populated with fields from the last previously filled record (if available). This allows the user to edit details without having to re-enter past valid data.

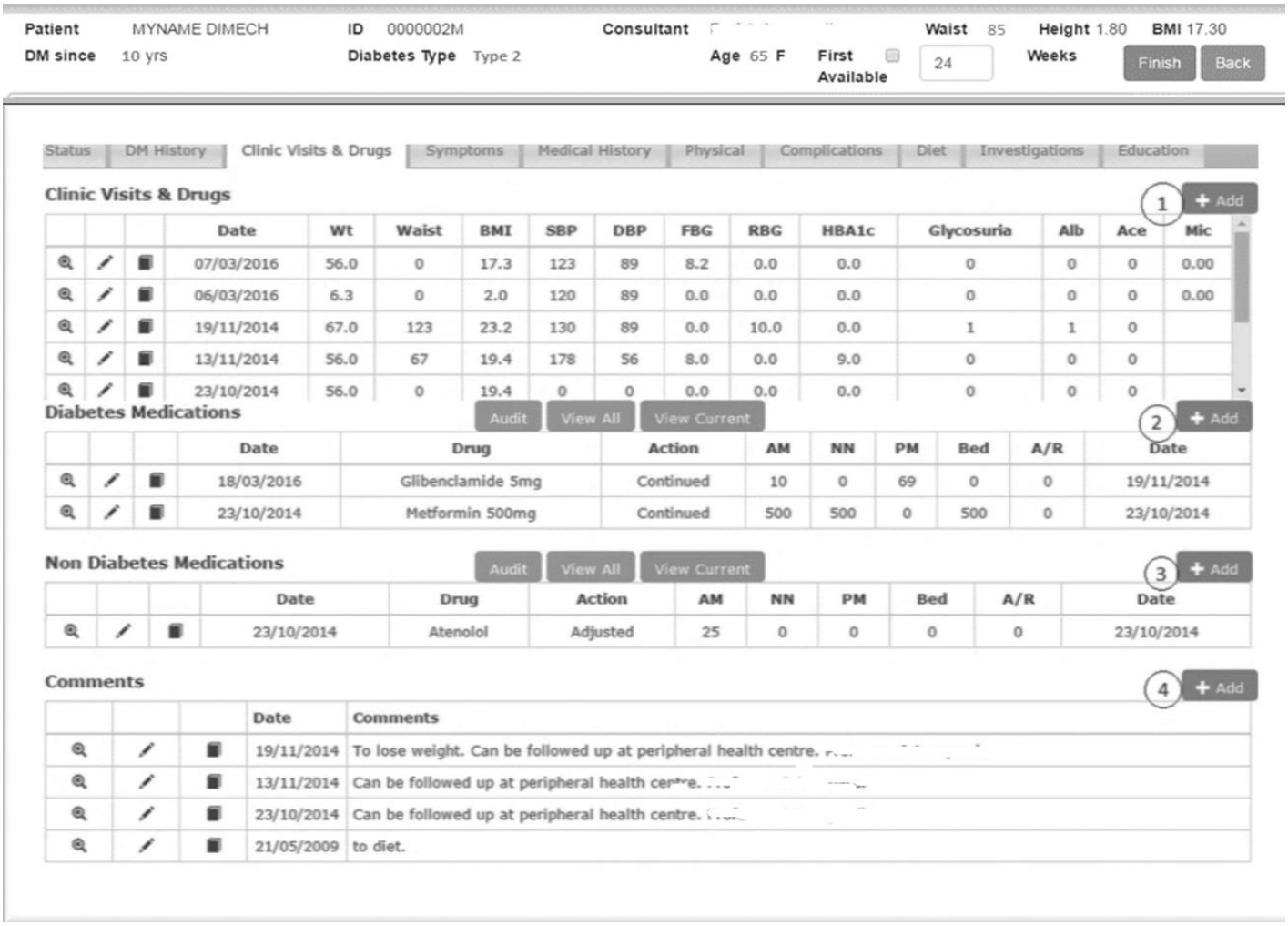
The following is a detailed description of the Clinic Visits & Drugs Form followed by a brief description of the other forms used in the system.

Clinic Visits & Drugs Form. See Figure 1. This is made up of four sub forms that contain routine parameters, diabetes and non-diabetes drugs and free text comments respectively recorded during clinic visits. The first sub form contains the routine parameters i.e. Date of Visit, Weight, Waist circumference, BMI, Blood Pressure, Fasting and/or Random Blood glucose, Hba1C, Glycosuria, Gross proteinuria, Acetonuria and Microalbuminuria. Clicking the **Add button (1)** opens a pop-up window to input new routine parameters. Only one routine parameter record can be added per patient for a particular day.

Clicking the **Add button (2)** and **Add button (Register)** opens pop-up windows to input Diabetic and non-Diabetic Medications respectively. There is a facility for viewing current as well as previously taken drugs.

Clicking the **Add Free Text button** in any window opens a popup that allows the user to enter free or pre-defined text from a drop-down list.

Figure 1*: Clinic Visits & Drugs Form. This has four sub forms for routine parameters, diabetes and non-diabetes drugs and free text comments. Each form can be manipulated through the Add* + Add *, Edit or View buttons. Only one routine parameter record can be added per patient for a particular day. The View Current button in the Drugs sub-form lists currently taken drugs and the View All Button lists current and previously taken drugs.*



Other Forms

Other forms in the system contain the Patient Visit History, Patient Diabetes Status containing the result of Oral Glucose Tolerance Testing if performed, Type of Diabetes and Complications, Diabetes History, Diabetes complications related symptoms, Medical History, Physical examination, Complications, Diet, Investigation results and Education.

Generating Reports

The system can produce data for research and administrative reports in Microsoft Excel worksheet form. These reports include:

1. Data(B.I.R.O.) Export reports. These generate extracted data from the various tables in the database. Table 1 shows a sample of some of the data produced. The complete list of the data in the B.I.R.O. Export Reports include basic patient data, physical examination data, basic laboratory investigations, end stage complications, medications, modes of therapy, self-monitoring and education status.
2. User Audit reports. These list users, names and ID Card Numbers of patients, dates of visits, and the dates the records were created or updated
3. Patients as per Consultant Reports. These list patients as per Consultant, with names and ID cards.

Table 1: *Some representative data taken from the Data (Biro) Export Report. The report can generate data from 48 clinical parameters, including Basic Patient Information, Risk Factors, Measurements, Assessment, Outcomes, Treatment and Education. Data for Type of Diabetes and OHA are coded. Patient identifiers have been left out.*

Date	Type	Sex	Diag	BMI	SBP	DBP	HBA_1C	CHOL	SMKR	OHA	Laser	MI	CVA
6/4/13	EH11	M	2013	25.9	130	85	8.4	4.88	No	2	No	No	No
8/3/13	UNK	M	1995	29.6	129	90		5.21	No		No	No	No
3/3/13	EH11	F	2012	38.5	142	75	7.1	6.27	No	2	No	No	No
9/3/13	EH11	M	1999	30.6	130	80	7.8	4.16	No		No	No	No
1/7/13	EH11	M	2000	27.7	110	70	8.8	4.86	Yes	2	No	No	No
6/7/13	R73	M	2008	24.3	130	90	5.9		No	2	No	No	No

Type=Type of Diabetes; Diag=Year of Diagnosis; BMI=Body Mass Index; SBP=Systolic Blood Pressure; DBP=Diastolic Blood Pressure; CHOL=Total Cholesterol; Laser: Laser Therapy applied; MI: Acute Myocardial Infarction; CVA=Cerebrovascular Accident; EH11=Type 2 Diabetes; UNK=Unknown; R73=Impaired Glucose Tolerance

The present system and the Maltese Diabetes National Register

Disease specific registers are databases containing data from patients with specific types of diseases[7]. Public care providers use the registers to monitor standards in order to help identify patterns of care and prevention, verify best practice guidelines and to develop recommendations to policy makers for best care delivery. The diabetes problem cannot be dealt with effectively if comparable data on the disease are not widely available. The system we describe in this paper can easily form the basis for the Maltese National Diabetes Register.

The statistics on diabetes are overwhelming. In the European region alone, the number of people with diabetes is about 60 million; and rising. Half of these people do not know they have the disease. Diabetes is the cause of serious complications and often leads to premature death. Worldwide, the disease kills about 3.4 million people annually; almost half are people aged under 70 years[8]. Standards of care vary widely across regions, with a considerable number of people receiving sub optimal care.

Much as we know, the need for more information on diabetes is obvious. For example, representative longitudinal data on quality of care and on morbidity and mortality are lacking in several countries. There is, in fact, a considerable amount of data that is often not easily available, fragmented, or poorly presented. This information can be much better utilized with better collaboration and sharing of information

A Diabetes register needs to include various data, including Patient Basic Identification data, Risk factors, Clinical Parameters, Measurements, Complications, Treatment, Self-monitoring and Patient Education.[9] Facilities for entering this data are in place on our system and in fact a considerable amount of this data is already present on the database. This can easily be extracted either through currently available reports or other reports created as per specific requirements.

Discussion

The diabetes problem has become globally epidemic.[10] Diabetes is the cause of serious complications and often leads to premature death. The disease is expensive to treat and complications are even more costly to treat.

Changes in care that improve the quality of diabetes care include implementing electronic health record tools. To deal with Diabetes effectively dependable data has to be available. This information is critical for problems to be recognized and resources used wisely to implement comprehensive strategies to correct these problems.

The World Health Organization(WHO) in 2016 urged nations to develop, maintain and strengthen a diabetes Register if feasible and sustainable, and include information on complications, noting that this can be more easily achieved when electronic medical files are used.[11]

The European Parliament in 2011 called on the European Commission to draw up common, standardized criteria and methods for data collection on diabetes.[12]

In this paper we show how our system keeps full track of clinic diabetes visits and generates research and administrative reports. We have also shown that our database can form the basis for a National Diabetes Register. At present use of the system is restricted to personnel in the diabetes clinics at Mater Dei Hospital and the Peripheral Health Centres. This use should eventually be extended to any doctor or health care personnel, whether in public or private service, working with people with diabetes. As the system is web based, this should not raise any technical problems. This will allow the system to be truly nationally representative. The system has a dataset shared with the EU EUBIROD System allowing for comparison of results with those of other systems across Europe. The system is a product of years of work with the present version having been updated in 2016.

There are a number of pending issues with the system. The system is not linked directly to the departmental system that contains patient laboratory test results and laboratory data has to be entered into the system manually.

Another problem is that use of the system is entirely on a voluntary basis and manual data records are still being used for some patients. What is needed is a departmental policy decision to ensure that all patient data is entered into the database. It is only then that the system will reach its full potential and fulfil meaningfully all its functions.

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Annex A

Development and Technical Description of the Present System

The COSTAR system mentioned in the paper used the MUMPS programming language and was used to gather diabetic data on a Burrows computer. In the early nineties a system running on a computer local area network (Novell, Inc, Provo, UT). and using a popular client-server database (FoxPro, Microsoft Corp, Redmond WA) was introduced and replaced the COSTAR system. This solution was later upgraded to a client-server application written in Visual Basic 6.0(VB6)[i] with a Microsoft SQL Server 2005 platform. This and the present system were developed by the Malta Information Technology and Training Services company (MITTS), later on the Malta Information Technology Agency (MITA)[ii]. The system is presently maintained by 2i Global Network Ltd,[iii]

The current system is a web-based application. The new web based application was built on the previous existing database schema but changes in the database structure were made. The underlying database platform was changed from SQL Server version 95 to an open source backend database – MariaDB version 10[iv] running over Windows. The system was built using the ASP.NET MVC 5 programming model[v] using Net 4.5 Framework[vi]. Entity Framework 5 was used to facilitate the data access. The Business Logic was implemented entirely as a Web API (REST) solution.

This web based application brought with it a number of advantages i.e. wider accessibility, improved interoperability with third party products, easier software Installation and maintenance, increased cross platform compatibility, reduced development and licensing costs and easier integration of other strategic partners within the operations of the System

The Data Layer in the system communicates with the Common Data Repository (CDR)[vii]; the CDR is a Government web service storing a citizen common dataset used across government departments in Malta.

The website layout and design of the new system makes use of bootstrap framework, making the system mobile friendly and easing the use of the system on mobile devices.

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