Toward a Customizable Effective Patient Management System for Ensuring Quality Medical Service

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Abstract—Ensuring a computer based quick and accurate patient management system has been a challenging goal for many years. And it adds additional challenges in undeveloped countries where the doctor-patient ration is quite higher than in the developed ones. In our research, we identified the user requirements and then addressed the issues from a software engineering perspective to find an easy, yet efficient solution for providing quick and accurate patient entry, management, and medication. The software also supports localization so that a quick press of a button can produce a report in the native language using a rule based translation system. A canonical combination of patient data analysis is also provided to have a quick view on the category of patients using different demographic criteria.

Keywords - Patient Management, Software, Information Visualization, Computer Application.

I. INTRODUCTION

With the advancement of software engineering and Information technology (IT), a lots of the practical, professional and personal fields are becoming largely automated by software applications. The medical sector and the health care is one of them which is already a nascent field in this respect and day by day it is getting more and more engaging with software applications.

In general, IT allows health care providers to collect, store, retrieve, and transfer various types of information electronically. IT is playing a vital role nowadays because it has the potential to improve the quality, safety and efficiency of health care. Some technologies and terms are often included in discussion of IT in health care - Electronic health record (EHR): EHRs were originally envisioned as an electronic file cabinet for patient data from various sources (eventually integrating text, voice, images, handwritten notes, etc.). Computerized provider order entry (CPOE): CPOE in its basic form is typically a medication ordering and fulfillment system. More advanced CPOE will also include lab orders, radiology studies, procedures, discharges, transfers, and referrals. Clinical decision support system (CDSS): CDSS provides physicians and nurses with real-time diagnostic and treatment recommendations. Automated dispensing machines (ADMs): This technology distributes medication doses. Electronic materials management (EMM): Health care organizations use EMM to track and manage inventory of medical supplies, pharmaceuticals, and other materials.

Quality health care relies on physicians, nurses, patients and their families, and others having the right information at the right time and using it to make the right decisions. Yet the health information needed to make these decisions changes frequently; the guidelines and clinical evidence continually evolve, as does knowledge about the condition of the patient. IT may provide a tool to store, integrate, and update this information base. Thus IT is continuously helping health care in terms of security, quality, efficiency, integrity, prudentially.

IT applications in health care can be divided into major two parts - first one is IT application for hospital usage and second one physicians usage. Generally they both have some similar and dissimilar features. In terms of administrative and financial point of view both usage should have billing, accounting, personnel and payroll but for hospital management patient registration, type of service needed other information is needed on the other hand for physician it is required to maintain the waiting list of patients, scheduling etc. In terms of clinical and infrastructure, there are also similarities and dissimilarities.

Primarily in this paper we propose an patient management software which is specially for physician usage. Apart from that it is customized for the developing countries like Bangladesh.

In countries like Bangladesh a physician has to take care of lots of patients. According to health-line, Bangladesh the physician-patient ratio is 1:4000 [1]. So a physician has to take care of many patients in a limited time interval. So quality prescription process, medication process is often not up to the mark. We have studied several general physician clinics and chambers in Bangladesh and our research lead us to some remarks like we can speed up the total process and also with proper prescriptioning and quality. Our study highlighted the pitfalls of the general procedure of these clinics and we also determined that some effective and intelligent changes could be brought to some sub-processes and inter processes during the whole medication process. With the help of IT we have striken the pitfalls and tried to ensure quality and more efficient medication procedure.

So eventually in this paper we have proposed an intelligent patient management software system focusing the developing countries that helps the physician in patient history, diagnosis, prescription, maintaining proper list of patients and etc. The primary motivation and purpose of the research work is how we can ensure more quality and efficient medication to our people, as physician has to take a lot of responsibilities. We have implemented this software with scrupulous attention to these matters and ultimately in practical use it was a success.

II. SOME RELATED SOFTWARE APPLICATIONS

A category of software that deals with the day-to-day operations of a medical practice is known as Practice management software (PMS). Such software frequently allows users to capture patient demographics, schedule appointments, maintain lists of insurance payers, perform billing tasks, and generate reports [2]. PMS is often connected to electronic medical records (EMR) systems. While some information in a PMS and an EMR overlaps - for example, patient and provider data - in general the EMR system is used for the assisting the practice with clinical matters, while PMS is used for administrative and financial matters. Practice management software has traditionally been commercial; few viable free practice management systems exist, though a few open source systems are under development. PMS usually costs about \$100 to tens of thousands of dollars to license and operate.

Some open source softwares are available like Dental Management and Patient Record - Open Dental is the first Open Source dental management package with very broad capabilities on record management, patient sceduling and dental office management [3]. For Electronic health or medical record there are softwares like FreeMED is a practice management and electronic and computer records system. It allows the tracking of medical data, in detail, with preservation not just of the diagnosis but the reasons for medical encounters [4]. FreeMedForms is a full set of medical applications (EMR, prescriber, drug interaction checker)). The project is administrated and developed by a community of medical doctors and computer scientists. The whole applications are freely available and are released with the full code source [5]. For Medical Practice Management Software there are ClearHealth covers the five major areas of practice operations including scheduling, billing, EMR, HIPAA Security and accounts receivable. It offers a fully comprehensive system which now offers tools like E-Prescribing, Drug Interactions, Electronic Labs and Lab ordering. It is the largest open source healthcare solution serving more than 500 sites including the Primary Care Coalition network in MD with 50 sites and around 100,000 patients [6].

On the other hand there are also some commercial softwares available. One of the popular such software is GP Desk. It has exciting and not limited features like - Store a complete electronic record of your patients' medical history. GP Desk includes allergies, problems, diagnoses, procedures, tests, medications, immunization, pregnancy, events/encounters which include symptoms, signs, joint mannequin, and a skin display. To assist you in managing your patients' health and your medical practice, GP Desk includes a scheduler for patient appointments, a disease monitoring system, a patient recall system, clinical tools (e.g. cardiac risk calculator), a billing system, a stock control system, and a user messaging system [7]. Another popular such software is PMP - Patient Management Program. Its main feature includes Schedule patients and book appointments easily, Process patient activity and manage patient accounts, Merge patient data to produce personalized communications, Generate statistical reports to help you analyze and improve your practice [8]. EzMedPro is another Medical Practice Management Software that will help clinicians automate their practice. This Medical Management Software integrates data entry, scheduling, Records Management, billing and reporting. Features like Manages Multiple Practices, Multiple providers per practice, Electronic Claims, Electronic Medical Records, CPT and ICD Code Management, Data Backup and Data Restoration are available on this [9].

Both these open source and commercial software have helped us in designing our software. We took many ideas from this kind of applications but our software is more customized in terms of timing and specially localization. Studies say that in developing countries there is almost no use of software application in physician clinics. So we have designed this application specially areas like Bangladesh. So we had to take into account some adaptive and effective design issue addressing the problems, pitfalls, and disadvantages of the medication process used in these areas.

III. OUR WORKS

We have addressed the issue of local problems like enormous patients, helping in possible acceleration of the process in short time interval, quality of medication, proper patient history reservation, flawless prescription report and over all user friendliness, ease of use and avoiding complications while designing our software. We also bring up some data mining and proper data interpretation concepts from the large patient data. Our Intelligent Patient Management System (IPMS) is a software to help physicians to manage their chamber and patients. It features a comprehensive waiting patients list management, setup of diagnosis, advices, diseases and surgery, database management, intelligent medication and multi-language support. It can run seamlessly in multiple PCs or in a single PC. Features of our designed application includes but not limited to

A. Waiting Patients List Management

We can add primary and follow up patients to the respective patient list. We can just select the date at which you want to add that patient, and the list of waiting patients at that day is shown.

B. Intelligent Setup to Facilitate Medication Entry

Most important part of the software is medication entry. And we gave our best effort to make this as easy, comfortable and quick for the doctors as it can be. It has been noticed that there are few medicines (May be 100 at most or so) that doctors have to prescribe every now and then. The user needs to save these medicines with details of its dosages. Now, when he chooses the medicine from the list of the treatment part, all other details



Fig. 1: Showing list of waiting and serviced patients.

Treatment Type	Description	PrescriptionID	Tablet Type	TabletName	Tablet Power	TabletPowerUnit	Dose	Hourly
Nasal Drop	TreatmentNasalDrop	-1	Tab	Typtin	10	mg	1	24
Nasal Spray	TreatmentNasalSpray	.1	Tab	Thomas	50	men	1	24
Ear Drop	TreatmentEarDrop	4	Tab	Sudada	60			
Inhaler	Treatmentlinhaler	-	180	2000011		110		
Other Inhalers	TreatmentOtherInhalers	-1	Tab	Sefurox	250	mg	1	12
Oral Gel	TreatmentOralGel	-1	Tab	Sandocal	500	mg	1	12
Oral Drop	TreatmentOralDrop	-1	Teb	Rocetrol	0	mcg	1	12
Kenalog	TreatmentKenalog	4	Tab	Rimectazid	300	mo	2	24
Pyralvex	TreatmentPyralvex		Tab	Baset	100		2	
Gel	TreatmentGel		100		100		-	-
Oument	TreatmentOmment	-1	180	Pleservox	100	mg	1	12
Other Onmerit	TreatmentOtherOmment	-1	Tab	PZA-Obe	500	mg	3	24
inj. Sodi Bi Carb	TreatmentSodilSk. arbing	-1	Tab	Pyrovit	20	mg	1	24
Lugor's loame	TreatmentLegolslodme	-1	Tab	Provitien AZ	0	mg	1	24
Nasal Ontment	Treatment/Vasad/unment	4	Tab	Paracutancel	500	m0	1	8
Tablet/Con	Treatment wound		Tab	Pastania	20			+2
Tablet Additional	TransmentTabletAddistallisence	-	160	Persona	40	my		16
Transfer Pediational	Treatment attention	- 4	Tab	Otoficur	20	mg	1	12
Special	TreatmentSuppository	- 4	Tab	Orfen	100	mg	1	12
Departion Unit	Duration Linit	-1	Tab	Oracyn-K	250	mg	2	6
TabletInstruction	TabletInstruction	-1	Tab	Omidon	10	mp	1	8
District Name	DistrictName	4	Tab	Neucestin P	160	-		12
Occupation	Occupation		7.0	News	120		-	-
NextVisitInstruct.	Next Visit Instructionn	1	TBD	Napa	500	mg	4	•
		-1	Tab	Myolax	50	ng	1	8
		-1	Teb	Mydocalm	50	mg	1	8
		-1	Tab	Kbec	250	mg	1	12
		4	Tab	Indever	10	mp	1	12
		-1	Tab	Frendt	0	m0	1	24
			T-1	Burn	46			10
			100		ev			16
		-1	Tab	Fiembutol	400	mg	25	24
		- 1	Tab	Duxi	0	mg	1	12
		-1	Tab	Deslor	5	mo	1	24

Fig. 2: An intelligent way to configure medication pririties.

like dose, durations etc are automatically filled. There are two levels of hierarchy. Priorities are first grouped on medicine type and then on medicine name. For example, when the user chooses Tablet category, among all the medicines belonging in tablet category, the top priority entry is selected and all 1 the information are filled. For example, if there are three tablets: Paracitamol, Flagil and Oradin in the tablet category and their priority are set to be 1, 3, and 5 respectively then when the user chooses Tablet, the row is filled with all the necessary information to prescribe Paracitamol. If you need to select Flagil, you can either select it from the list or you can write down and enjoy software intelligence to select the drug. Our second level priority works on each of the medicines. If there are 4 variations in prescribing Paracitamol, then the user can switch among them using keyboard shortcut (F11). This facility is quite useful as a few common medicines in more than 90% of the prescriptions. Our user appreciated this feature.

C. Multi-Language Support

Many of our patients are from rural areas, and it gets difficult for them to understand the advice and medication information if these is written in English. It would be easy and most appropriate for them if they can get it in their native language, which is Bangla. So we added Bangla support in



Fig. 3: Configuring the most common medicines used.

				Name
g Desme g Desme g Desperars g Desperars	Nate Desset	Trad Dueses	Ore Dense □ De Orene □ De Orene □ De Orene = 0 De Ore	Tet Supp Deams

Fig. 4: A Screenshot on configuring the software and using it.

such a way that it is easy to prescribe for the doctors and easy to understand for the patients! In the setup portions, once you have entered the minimum information in Bangla corresponding to English, then English and Bangla prescription is as easy as choosing a language. We understand that most of the doctors would feel at home in English. So prescription entry is in English and when you go to print this prescription, you choose the language option, and prescription is printed in that language – as easy as that.

D. Research Capabilities

Doctors often need to make a research on different aspects of their patients and their medication histories. So, besides a complete search based on the patients personal information, we have also provided an intelligent search capability on the medication histories of patients. You can use it to find unknown facts of your patients. We also provide the facility of graphical representation of the results found from our software using pie charts, Bar charts, etc. It can be very useful for professors to make an attractive multimedia presentation in medical conferences and such purposes.

Sea	archForm					
Selec	t all patients based on	the following informati	on:		Prescript	tions
🗆 P	atient code is like		Age 🗸	0 🔅 And 0 😂	15/06/	2005
Π Pi	stient Name is like		City Australia	Occupation Advocate) 23/06/	2005
	antino's Mana is like				08/10/	2005 2005
_ 0					19/10/	2005
A D	ddress is like		Status 🔘 Married 💿 Unma	arried		
Sear	ch Results: 8319 m	ows found.				
_	PATIENT_CODE	VISIT_DATE	PATIENT_NAME	GUARDIAN_NAME	AGE_YEAR	AGE_N
	2005-02-0017	02/02/2005	TAHMINA AKTER LIZA	DELAWER HOSSAIN	21	0
	2005-02-0018	02/02/2005	NURJAHAN BEGUM	SAFIULLAH	59	0
	2005-02-0019	02/02/2005	KOHADAZA BEGUM	MAKUL HOSSAIN	35	0
	2005-02-0020	02/02/2005	ABDUL ALIM	RAJOB ALI	22	0
	2005-02-0021	02/02/2005	AYAN	HABIBUR RAHMAN	6	1
	2005-02-0022	02/02/2005	AFRIFUL HUQE	KURSHAD ALAM	19	0
	2005-02-0023	02/02/2005	MD.MINUL HOSSAIN	MD.ABUL HOSSAIN	22	0
	2005-02-0024	02/02/2005	NASIR CHOWDHARY	LATE. HABIBUR RAHMAN CHOWDHARY	50	0
	2005-02-0025	02/02/2005	MOTIUR RAHMAN	LATE HABIBUR RAHMAN	46	0
	2005-02-0026	02/02/2005	AKTARUZZAMAN	LATE JAHIRUDDIN BHUIYAN	50	0
	2005-02-0027	02/02/2005	ABDUR ROB	MAHEDI MIA	45	0
	2005-02-0028	02/02/2005	LABONNO	SAYED ABDUS SALAM	22	10
	2005-02-0029	08/02/2005	ANWAR HOSSAIN	RAFIQUEL ISLAM	43	0
	2005-02-0030	02/02/2005	AMINA BEGUM	ZAKIR HOSSAIN	37	0
	2005-02-0031	02/02/2005	MRS.HOSNE JAMAL RAFIQ	MR. RAFIQ AHMED	62	0
	2005-02-0032	02/02/2005	MINHAZ	NASIM UDDIN MOLLAH	3	10
۲	2005-02-0033	23/06/2005	MD. ESRAZUL ALAM	LATE HAFIZUL ALAM	60	0
	2005-02-0034	02/02/2005	AYSHA BEGUM	DALIL UDDIN	34	0
	2005-02-0035	02/02/2005	SAHANA BEGUM	MD.ASADUDDOWLA KHAN	33	0
	2005-02-0036	03/02/2005	FAHMIDUL ALAM	DEDARUL ALAM	13	0

Fig. 5: The search option allows to find previous user and study on users demographic properties.



Fig. 6: One screenshot for customization.

E. Networked or Single Mode

This software can be used in a client server network mode or in n a single PC mode. In networked m mode, one computer is used as a server, and others are used as clients. All these computers work seamlessly and everyone sees the same thing. Whenever an update is made, say a new patient is added in the waiting patients list, the change is reflected in a all computes. You can use one printer and can print in that from all computers in that system. Not only this, as long as your server is unchanged, you can add more and more client PCs as you need. You do not need to configure the software for this.

F. Patients Full History

We have maintained the lists

- 1) Waiting patients list
- 2) Prescribed Patients list
- 3) Patients history

Whenever we select a patient from prescribed patients list or waiting patients list, the treatment history of that patient is shown in the third list, from where you can open and modify the old prescription. You can save the modified prescription and can also save it as a new prescription at the current date.

G. Intelligent Search Features

Searching is needed for many purposes. You may need to find the previous prescriptions of a follow up patient who lost his/her previous prescriptions and dont know his/her patient ID. With our intelligent search engine you are guaranteed to find that patient within a few seconds. Searching can be done based on all possible information of that patient name, age, range, sex, occupation, district, address, code, etc.

H. Ease of Use

We did not provide any clumsy and unnecessary features in the software because that makes it difficult for the users to use the software efficiently. Rather we wanted to make it very easy for the user so that very little computer knowledge is required. Everywhere we provided intelligent sense (we call it *intellisense*) so that minimal typing is required. We have provided provision of using both the mouse and keyboard in almost everywhere, because we found that some users feel it easy to do everything with keyboards. We gave our best effort for our users, and we are ready to facilitate them with extra features to meet their requirements.

I. Customizability

The software is fully customizable. Even even a novice user can change all the features discussed dynamically graphically. The options and lists are stored in database and an easy user access mechanism is provided to change them. Subsequent changes in child tables are also taken care of.

IV. SYSTEM DESCRIPTION

We followed a two tier architecture to make the system robust as well as less resource hungry then the three tier architecture. We have developed the software using Visual Studio and .NET 2.0. We have used Microsoft SQL Server as the relational database in the back end. We have tested our software on a Pentium three, Pentium D and the latest Intel Core 2 Duo based CPU and also with Microsoft windows XP Service pack 2 and 3. The software should be compatible with future versions of the operating system and related hardware as it did not depend on any special feature of them, or may require minimal change, thus ensuring a cost effective stable solution for the users.

V. REAL WORLD EXPERIENCE

Our project has been deployed in the private chamber of Dr. Zaheer Al Amin, the Head of the ENT Department of Bardem Hospital, Dhaka, Bangladesh. They have used the system for more than a year. Data on about 20000 patients has been collected and the system has been tested extensively to meet the user requirements and performing in the real field. It has been reported as very convenient by the doctors working in there.

VI. FUTURE WORKS

We are working on to integrate some other managerial portions to our software. Especially we are investigating to incorporate the accounting part that a doctor may require. Also a common/standard interface at the database end may help us to integrate our system with external softwares.

VII. CONCLUSION

Having a technologically sound solution for sophisticated yet efficient and easy to use patient management software has been a goal for many years. Through our research and developed software, we have been able to focus light on some aspects of it. We will continue extending our work and hope to have an impact on the improvement of public health facilities.

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