

DEVELOPMENT OF A SYSTEM FOR EXTRACTION OF PATIENT DRUG PRESCRIPTION FROM CLINICAL NOTES

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ABSTRACT

Doctors are saddled with the challenges of writing clinical notes which serve as a form of documenting the patient's clinical histories and at the same time write a drug prescription for pharmacy to dispense. This manual process of documentation and writing of prescription is very tedious, stressful, involves duplication and time consuming, most especially for hospital that have hundreds of patients that needs diagnosis. This paper deals with the extraction of drugs prescribed by doctors in the clinical note of the patient. The developed system was designed using MySQL and Visual Basic.NET. The system also takes into considerations the registration of patients, diagnosis by the Doctor and reports on patient's history. A total number of 50 drugs and illness were generated in the library used and four different samples of clinical notes were collected from Doctors to test run the system. It was able to extract the drug prescribed as written in the clinical notes successfully.

Keywords: *Clinical Notes, Prescription and Extraction*

1. Introduction

The truth is that the world is fast becoming a global village, as a result of development in Information and Communication Technology (ICT). The key instrument in this globalization is the computer. Computer mediated communication is increasingly becoming the fact of every life, particularly in the developed and some developing countries. In these countries, information technologies have changed how people live, work and play, of which Medical sector is not left out of this ware of change (Berenfed, 1999). Since the emergence of ICT which is regarded as the bedrock of national survival and development in a rapidly changing global environment, every progressive country has a national IT policy and an implementation strategy to respond to the emerging global reality and thus avert becoming a victim of digital divide (Mustapha, Ayokunle & Salihu, 2013).

Clinical note are the part of a medical record where healthcare professionals record details to document a patient's clinical status or achievements during the course of hospitalization or over the course of outpatient care (Rector, Glowinski, Nowlan & Rossi-Mori, 1995).

Clinical note which is sometimes called Progress notes, are written in a variety of formats and details, depending on the clinical situation at hand and the information the Doctor wishes to record. One example is the Subjective, Objective, Assessment and Plan (SOAP) format, where the note is organized based on these four sections. Another example is the DART format, it is organized into Description, Assessment, Response, and Treatment. Documentation of care and treatment is an extremely important part of the treatment process in a hospital. Clinical notes or

Progress notes are written by both physicians and nurses to document patient care on a regular interval during a patient's hospitalization (Nygren & Henriksson, 1994). Progress notes serve as a record of events during a patient's care, it allows physicians to compare past status to current status, serve to communicate findings, opinions and plans between physicians and other members of the medical care team, and allow retrospective review of case details for a variety of interested parties (Huff, Rocha, Bray, Warner & Haug, 1995).

Every clinical note should be readable, easily understood, complete, accurate, and concise. They must also be flexible enough to logically convey to others what happened during an encounter, e.g., the chain of events during the visit, as well as guaranteeing full accountability for documented material, e.g., who recorded the information and when it was recorded. Physicians are generally required to generate at least one clinical note for each patient encountered. This documentation is then included in the patient's chart and used for medical, legal, prescription and billing purposes (Nygren & Henriksson, 1994).

Once the patient comes to the hospital, the doctor will diagnose, write a clinical note and at the same time write the prescription details for the pharmacy, this prescription details is usually among what the Doctor has written in the clinical notes. Then, the patient will go to the pharmacy and the pharmacist will view the prescription details and dispense the drug. After that, the patient will pick the drug(s) and leave the clinic.

Patients diagnosis is done manually where doctor will write the report on the sheet of paper known as clinical notes, write the prescription form and then send it to the pharmacy, the pharmacist will have to read through the paper in order to get the drug(s) prescribed by the doctor. In other words, the existing method requires the Doctor to pass through the stress of writing the clinical notes and at the same time write the prescriptions form for the pharmacy; with the aid of the proposed system, the doctor will only type the clinical notes while the system will extract the prescription details from the clinical notes and send it to the pharmacy to dispense the drugs.

This Extraction of Patients Drug Prescription from Clinical Notes (EPDPCN) will be beneficial to both the clinic and the doctor because it will reduce the stress the doctor is passing through in diagnosing the patient, documents the illness and treatment and at the same time write the drug prescribed to the pharmacy for dispensing. This paper intends to use the benefits of Computer as one of the ICT tools to show case how important is the wonders of ICT in our day to day activities. This proposed system is developed using Visual Basic.NET and MySQL to extract the prescriptions details in the clinical notes.

2. RELATED WORK

Clinical notes contain rich medical information, such as the patient's symptoms, current medication prescriptions, examination findings, lab/x-ray results, etc. In recent years, many systems have leveraged Natural Language Processing (NLP) technologies to extract information embedded in clinical notes. Some of the related works are:

Medical Language Extraction and Encoding System (MedLEE)

The goal of MedLEE is to extract, structure, and encode clinical information in textual patient reports so that the data can be used by subsequent automated processes (Carol, Lyudmila, Socrates and Xiao, 1996). This system is developed based on NLP approach to automatically encode data that is in textual form.

Annotation Analysis for Testing Drug Safety Signals using Unstructured Clinical Notes

This system is based on using the rich contents of Clinical notes to prevent adverse drug events. The symptoms recorded in the clinical notes are used to test the drug safety of a patient. The system describe the application of simple annotation tools on clinical text and the mining of the resulting annotations to compute the risk of getting a myocardial infarction for patients with rheumatoid arthritis that take Vioxx. The analysis clearly reveals elevated risks for myocardial infarction in rheumatoid arthritis patients taking Vioxx (Paea, Srinivasan, Cedrick & Nigam, 2012).

Apache Clinical Text Analysis and Knowledge Extraction Systems (cTAKES)

The cTAKES is a modular system of pipelined components that combines rule-based and machine learning techniques aiming at extracting information from the clinical narrative. The gold standard datasets for the linguistic labels and clinical concepts are created on content that is a subset of clinical notes from the Mayo Clinic Electronic Medical Records (EMR). Standard evaluation metrics are used to measure the quality of the gold standards and cTAKES performance. It is experimented on a large open source EMR and the system is build based on Natural Language Processing (Guergana et al., 2010).

Another work that extracts information from clinical note is AMBIT (Acquiring Medical and Biomedical Information from Text), it was developed within the context of two e-science projects: Clinical E-science Framework (CLEF) and myGrid. The myGrid project aims to present research biologist with a single unified workbench through which component bioinformatics services, including services for text mining over biomedical abstracts, can be accessed using a workflow model. The goal of CLEF project is to provide a repository of structured and well-organized clinical information which can be queried and summarised for .Obiomedical research and clinical care. Specifically, it extracts information regarding the treatment of cancer patients. The treatment of such patients may extend over several years and the resulting clinical record may include many documents, such as case notes, lab reports, discharge summaries, etc, we aim to identify a number of significant classes of entities. Including patients, drugs, problems (i.e., symptoms and diseases), investigations and interventions, and relationships between such entities, e.g., that an investigation has indicated a particular problem, which, in turn, has been treated with a particular intervention (Gaizauskas et al., 2003; Harkema et al., 2005).

Most of the systems reviewed are based on large systems which used Natural Language Processing (NLP) and Text mining approach to information from clinical notes, but the proposed system is developed to extract illness and drugs prescribed, provide a brief overview of patient information and then create a library of drugs and illness from which the system is used to build the extraction system.

3. METHODOLOGY

System Design

For the purpose of extracting this drugs properly, the system designs entails the Doctor, Pharmacy, Nurses and Patients to fill some forms in other to get registered and have an

identification number. Most of these forms are: Login Form, Patients Form, Diagnosis form and Pharmacy form.

Login Form

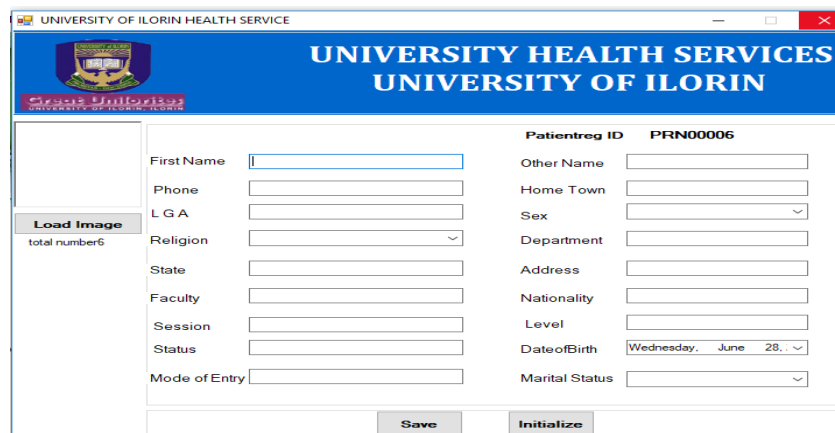
The login form is a very important form, it is a form that allows the authorised user login to the system and performs defined activities. Figure 1 is a sample of the Login form



The screenshot shows a web browser window titled 'ADMlogin'. The header features the University of Ilorin logo and the text 'UNIVERSITY HEALTH SERVICES UNIVERSITY OF ILORIN'. Below the header, there are two input fields: 'User Name' and 'Password'. At the bottom of the form, there are two buttons: 'Login' and 'Cancel'.

Patient Form

The patient form will allow patient to fill their details and be able to gain admission into the hospital for proper registration process. The Patient Form is an important prerequisite for patient diagnosis in the Hospital Activities. It also allows the Hospital staff to monitor, supervise and pay close attention to patients even after they have been discharged.



The screenshot shows a web browser window titled 'UNIVERSITY OF ILORIN HEALTH SERVICE'. The header features the University of Ilorin logo and the text 'UNIVERSITY HEALTH SERVICES UNIVERSITY OF ILORIN'. Below the header, there is a 'Load Image' button with a 'total number6' label. The main form area contains two columns of input fields. The left column includes: First Name, Phone, LGA, Religion (dropdown), State, Faculty, Session, Status, and Mode of Entry. The right column includes: Other Name, Home Town, Sex (dropdown), Department, Address, Nationality, Level, Date of Birth (calendar), and Marital Status (dropdown). At the top right of the form, 'Patientreg ID' is displayed as 'PRN00006'. At the bottom, there are two buttons: 'Save' and 'Initialize'.

Diagnosis Form

The Diagnosis form is to be filled by the doctor who performs the diagnosis on the patient. After the diagnosis must have been completed and prescription has been made, the doctor can then perform the summary and save record into the database. This is a form that has replaced the manual clinical notes of the patient.

Figure 3: Diagnosis Form

Prescription Form

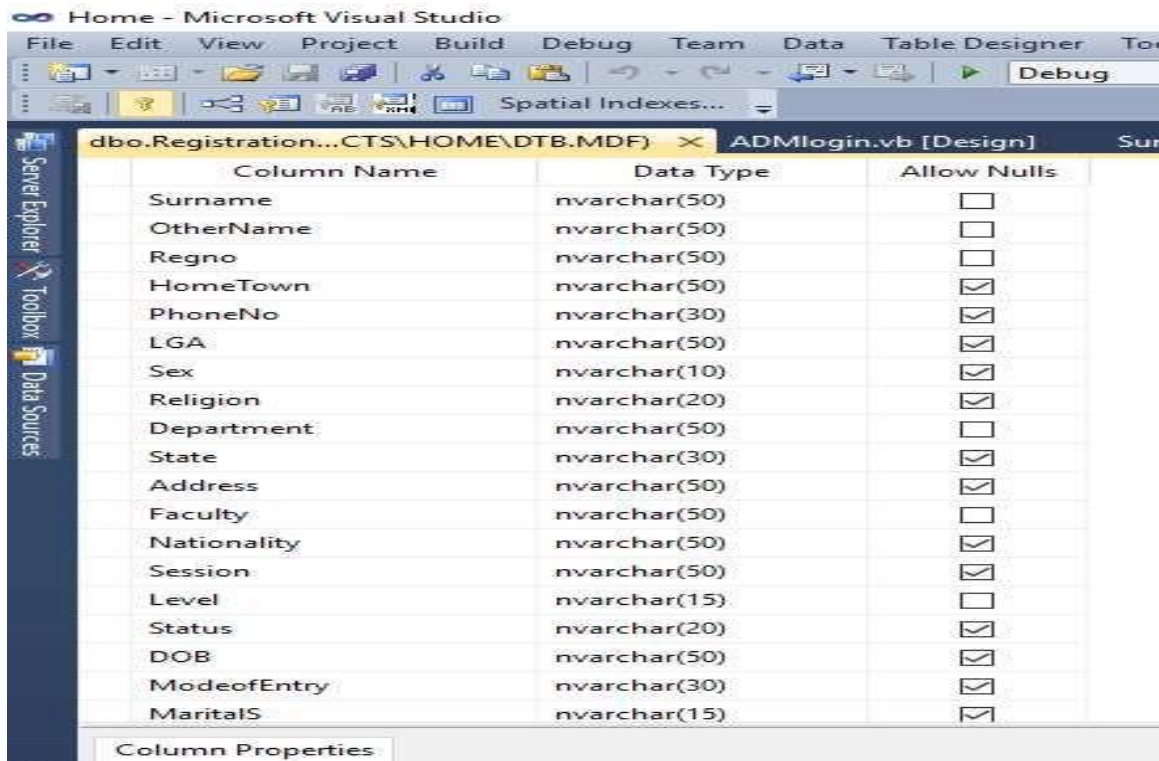
The prescription form is a form that can be viewed by the pharmacist, it displays the summary of the details of a patient diagnosed, display the illness and the prescribed drug(s) to the pharmacist. This is a form that serves as the prescription form in the manual process.

Database Design

MySQL database was used for this system because of its simplicity, readily available and easy to use as well as the language program used is attached with it already. MySQL performs the following functions:

Table 1 declares the various field for the data type as it is used to fill in the patient description and stored in the database and the structure of its length and width.

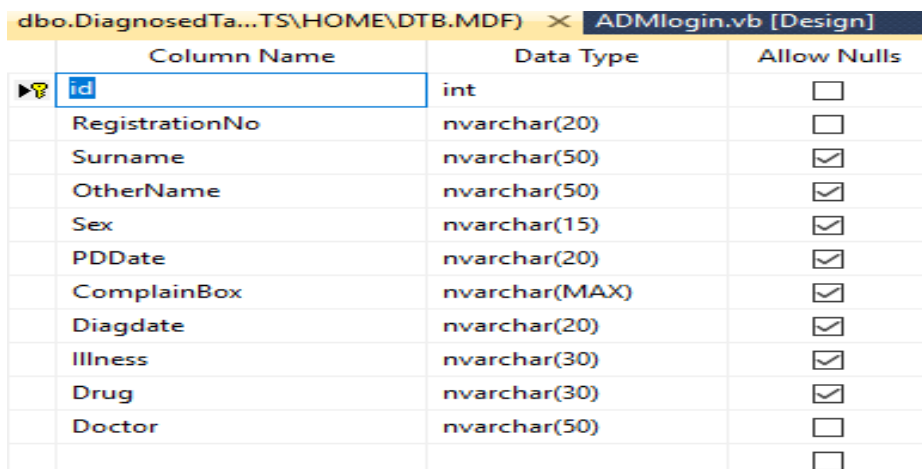
Table 1: Registration Table



Column Name	Data Type	Allow Nulls
Surname	nvarchar(50)	☐
OtherName	nvarchar(50)	☐
Regno	nvarchar(50)	☐
HomeTown	nvarchar(50)	☒
PhoneNo	nvarchar(30)	☒
LGA	nvarchar(50)	☒
Sex	nvarchar(10)	☒
Religion	nvarchar(20)	☒
Department	nvarchar(50)	☐
State	nvarchar(30)	☒
Address	nvarchar(50)	☒
Faculty	nvarchar(50)	☐
Nationality	nvarchar(50)	☒
Session	nvarchar(50)	☒
Level	nvarchar(15)	☐
Status	nvarchar(20)	☒
DOB	nvarchar(50)	☒
ModeofEntry	nvarchar(30)	☒
MaritalS	nvarchar(15)	☒

Table 2 declares the various field for the data type as it is used to fill in the patient diagnosis form and stored in the database and the structure of its length and width.

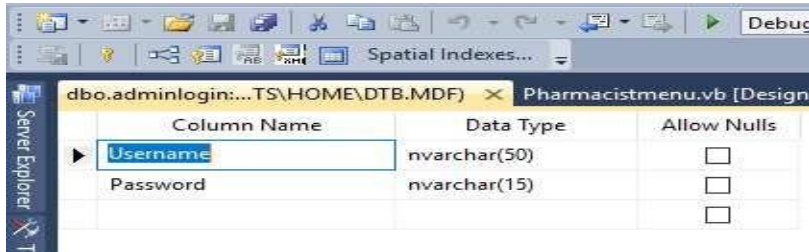
Table 2: Diagnosed Table



Column Name	Data Type	Allow Nulls
id	int	☐
RegistrationNo	nvarchar(20)	☐
Surname	nvarchar(50)	☒
OtherName	nvarchar(50)	☒
Sex	nvarchar(15)	☒
PDDate	nvarchar(20)	☒
ComplainBox	nvarchar(MAX)	☒
Diagdate	nvarchar(20)	☒
Illness	nvarchar(30)	☒
Drug	nvarchar(30)	☒
Doctor	nvarchar(50)	☐

Table 3 requires parameters for user login

Table 3: Login Table



Column Name	Data Type	Allow Nulls
Username	nvarchar(50)	☐
Password	nvarchar(15)	☐

4. RESULTS AND DISCUSSIONS

In other to experiment the developed system, real clinical notes obtained from Doctors were used to test run the system. Figure 5 is the result of a doctor diagnosing a patient.



UNIVERSITY OF ILORIN HEALTH SERVICE

UNIVERSITY HEALTH SERVICES
UNIVERSITY OF ILORIN

COMPLETE DIAGNOSIS Patient ID: PRN00003 Load

Patient Info
First Name: MRS A.M
Other Name: B
Sex: FEMALE
Date of Birth: 04/02/1976

Dignose Area
Vaginal discharge is yellowish in colour, copious, not foul smelling and not cheese-like. There is associated occasional history of hotness in the abdomen. Patient is married into a polygamous family of three wives and the husband has extra-marital affairs. However, there is no history of multiple sexual partners in the patient. She gave nil history of rash in the genital area, no swelling in the genital or

3/ 8/2018

Diagnosis: Pelvic-Inflammatory-Disease

Drug Prescribed: Cap-Doxycycline-200mg, Tab-Metronodazole-400mg, Cap-Fluconazole-150mg

Doctor's Name: Smith Williams

Get Summary SAVE

Figure 5: Diagnosis Result

The diagnosis area is the clinical notes typed by the Doctor.

RegistrationNo	Illness	Drug	Diagdate
PRN00003	Pelvic-Inflammatory-Disease	Cap-Doxycycline-200mg, Tab-Metronodazole-400mg, Cap-Fluconazole-150...	3/8/2018

Figure 6: This is the prescription form that will be sent to the pharmacy for drug dispensation.

Figure 7 is a report form that displays the information of all patients that have registered with the clinic

Regno	Surname	OtherName	HomeTown	PhoneNo
PRN00001	FRANKLIN	JAMES	LAGOS	08062476482
PRN00002	SHODOLU	WASIU	LAGOS	08062476482
PRN00003	OWOLABI	AINA	ILORIN	08035476753
PRN00004	ADEBAYO	MUNIRAT	ILORIN	07098654321
PRN00005	ISMAIL	NURUDEEN	IAGOS	08033549586

Figure 7: Sample Report

The results obtained shows that prescription details from clinical notes is possible even without using NLP and Text mining approach. The samples result in figures 5 and 6 shows how the drug and the illness extracted from the clinical notes is seen on the prescription form for pharmacy to dispense.

5. CONCLUSION

Based on the objectives of this study and the various analysis made, it is hereby concluded that the important of Information Technology (IT) cannot be underrated as far as medical management is concerned. The system developed is able to reduce the stress the Doctors are passing through in writing clinical notes and at the same time writes the prescription details for patients. The work can be extended to have more drugs and illness in the library and also experiment it with a large system.

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