Preparing to Use Informatics Medicine, and Trends in the Age of Meaningful Use

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Abstract-- **Mistaken or wasted medicine has been a problem to Taiwan government, not only the caused worsen condition of patients' health by mistaken medicine but also, the wasted or thrown away medicine may led Taiwan government medicine expense costly and environment pollutions as well. According to Taiwan government records that, there is more than 130 tons (t) medicine had been abandoned in year 2011. The most obviously reasons for people abandoned medicine are, self-adjusting or self-stopping medicine by themselves; sharing medicine with friends; forgetting or mistiming of taken medicine.**

In the experiment, we intended to provide a web-based portal to assist patients for searching the medicine side effects information via our dataset of medicine definition or compounds, usage notice, side effects and so on. The dataset contained and integrated from medicine manufactures prescriptions and pictures and two medical centers, which based on Taiwan government provided medicine database, and in addition, the result information from web surfing in the text mapping search engine will also be considered as well.

The dataset itself needs to be leveraged and structured as the promise of meaningful use. We consider linking the chronic disease management such as kidney disease and asthma for medicine suggestions between patients and health providers.

I. INTRODUCTION

Taiwan has had a significant government-funded single-payer universal national health insurance (NHI) policy since 1995 [1]. Taiwanese residents are required to pay a monthly fee for this mandatory public insurance based on a variety of salary or source-of-income scales. Residents with lower incomes pay less than those with higher incomes. Taiwanese are generally satisfied with the NHI program. One NHI investigation of user satisfaction with the insurance reported that satisfaction levels rose from 65.35% in 2001 to 88.2% in 2010 [2].

Because there are more than 10,000 public and private hospitals and healthcare clinics on the small islands that make up Taiwan, it is convenient for most of its 23 million residents to visit a healthcare facility for treatment. In fact, many of Taiwan's people visit two or more different types of clinics in one day; therefore, they may get treatment and prescription medications for more than one medical malady on any one day. The low cost and instant availability of medications (they are almost always dispensed by a pharmacy inside or next door to the clinic or hospital) often leads to patient noncompliance with their medication regimen. For example, some patients might choose to take one prescription only once instead of for the full course provided (usually only three days with a requested follow-up visit to see ~~if~~ whether more drugs are needed). Some patients might visit more than one clinic or hospital for the same malady and get multiple prescriptions for the same or different medications. Many other patients may reduce their doses or even stop taking their medication as soon as they feel better, especially highly educated and young people [3].

Moreover, many people who visit practitioners of Chinese and Western medicine (both types of treatment are covered by NHI) for the same malady may cause them to waste their Western medications. Furthermore, many people will share their medicine with a spouse, children, other relatives, and even their pets, especially drugs for fever or cough symptoms.

Many hospitals and medical centers are usually filled with patients waiting to see doctors, therapists, and phlebotomists. Some are as crowded as Taiwan's extremely popular farmers' markets on holidays and weekends. For example, a patient who visited clinic A for a cough or fever yesterday is free to go to another clinic for the same symptoms today—small private clinics are significantly cheaper than hospitals and major medical centers (about one-third the cost for registration and treatment, even less for patients over 65, and the basic medication is usually included in the registration fee)—and they may be given another prescription for three more days of the same medicine. This is a cultural problem related to traditional Chinese customs.

In general, patients taking the wrong medicine or wasting their prescribed medicine by not using it or by giving it to others have been problems for Taiwan's government: not only do they often lead to the worsening of a patients' health, but wasted medicine costs the Taiwan government and its taxpayers money. Moreover, when unused medicine is thrown out (especially when it is disposed of in rivers, streams, and lakes), it pollutes the environment. Taiwan's government reported that more than 136 tons of medicine was thrown away in 2012 [4]. Most of those drugs were for fever, hypertension, hyperlipidemia, and hyperglycemia, and they were valued at NT$258 billion (US$860 million) [5]. The most common reasons people throw away their medicine are that they lower their doses or stop taking the drugs on their own advice rather than a physician's, they share their medicine with others, and they forget to take their medicine or else take it at the wrong time. Medicine abuse involves use, overuse, and misuse. In this study, we designed and implemented a platform that contains local, governmental, and global information to help medicine experts educate the public about how to properly use medicine.

II. METHODS

Information Communication Technology (ICT) is used in

many fields, and its use in healthcare has been growing for more than a decade [6]. In this study, we planned to develop a web-based platform to provide users a challenge to collect, record, analyze, and share medicine knowledge with user groups in different stages.

A. System Infrastructure

The system was developed in three tiers. The application server and the domain controller were for managing the requests from and displays for users; the database server was mirrored and isolated for security reasons. The analyzing and searching runs at the processing layer. The development tools are JAVA, JavaScript, Spring Framework, Apache Lucene, Apache Wicket, and the PostgreSQL database (Fig. 1).

B. Function sets

1) Basic information checking: at the beginning, we integrated a platform to generate the information relevant to a medicine, viz., the manufacturer, main components, photos of the medicine, and the official statement about the medicine. The information was selected from NHI records of medicines approved by the Taiwanese government to be used in hospitals and clinics. Based on the basic government-provided dataset, we implemented a surfing function for users to search the Internet for additional information, e.g., side effects.
2) Interaction checking on the Internet: medicine vs. medicine, medicine vs. food, medicine with time tables, and Western medicine vs. Chinese herbal medicine. We used Natural Language Processing (NLP) [7] to generate the search engine, and text-mapping searching in both English and Mandarin Chinese.
3) Drug historical data: government-provided historical data about drug usage is included for system users.
4) Personal drug suggestions: this function allows and encourages individual patients to record their current medications and the effects of those drugs. Newly input data will be used to generate graphs showing new trends of how people react to their medications.

C. Design evaluation

The system will serve as a search and education platform both for patients with chronic diseases and for healthcare providers. We invited 35 patients (12 with chronic kidney disease) and 4 healthcare providers to participate in the system evaluation, which was done in a clinic. At the beginning, four healthcare providers had learned to operate the system in a literal way; they helped to check the accuracy of the results of basic drug information on the website. Two healthcare providers were in charge of recruiting 35 patients to participate in the study, but only 12 of them were willing to participate in the evaluation of the system. In addition to teaching patients how to use the website to gather drug information, the healthcare providers encouraged the patients to record how the drugs they took affected them so that their health conditions could be consistently fully controlled. In the clinic, the healthcare providers explained the system to patients, who then created and registered their new user accounts. Patients were required to record their information twice a day: in the morning and at night for three months until their next clinic visit. After the experimental period, we planned to adopt the modified think-aloud [8] design protocol to elicit the participants' perspectives on the prototype's platform advantages and disadvantages. The main approach of the think-aloud protocol is to gather data when doing usability testing of a product. The protocol is programmed to recognize and report usability problems.

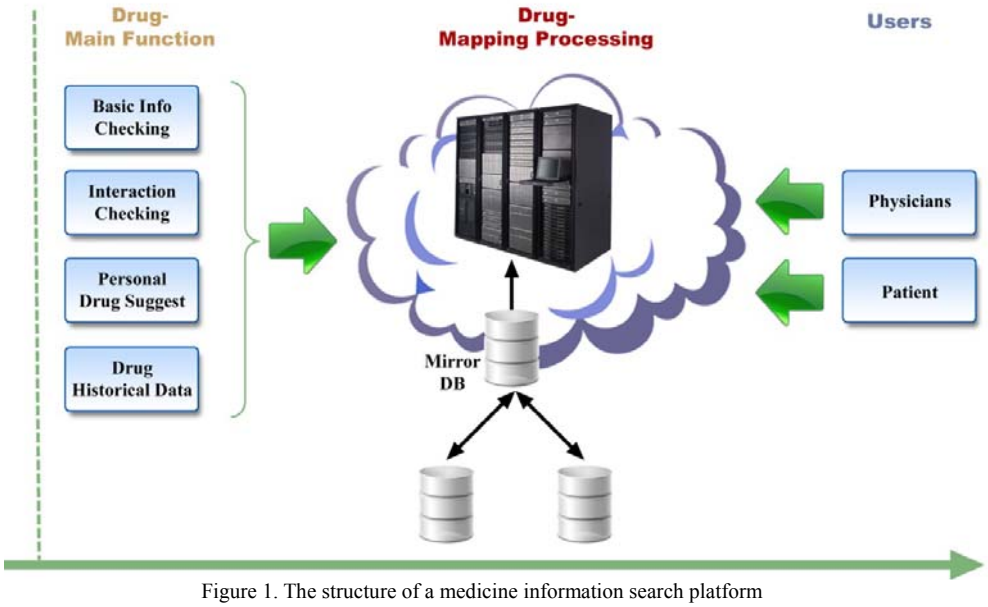

Figure 1. The structure of a medicine information search platform

III. RESULTS

Our evaluation was based on the platform utility and face-to-face interviews with participants. We selected middle-aged participants (mean age: 51 years; 9 men, 3 women) with basic Internet skills and knowledge.

Our qualitative analyses revealed two themes about the operation of this platform for supporting drug information checking, and whether or not the participants thought that using it was meaningful.

A. Patients searched their prescription medicine on websites

Ten participants said that the criteria for mapping with words or text were not easy, because they were not sufficiently familiar with English. However, all of them appreciated that the platform allowed them to obtain drug-relevant knowledge that might protect them from eating the wrong food or taking the wrong medication.

> "*It isn't easy for me to type in English, especially when the name of the drug is very long and the spelling is quite odd…but I like the outcome. I never noticed that I was thirsty when I was taking this medication, but now I recall that…I was thirsty then, but I just didn't pay attention to it!*"

> "*I hardly think of getting drug information on my own, besides what my healthcare providers offer me while visiting clinics. I guess I'm lazy and never thought about wanting to understand more the drugs I was taking. I feel ashamed about that now.*"

B. Meaningful use of this platform related to their health

Participants and healthcare providers all agreed that finding extra information about the prescribed medicine is more meaningful than having only one official statement from physicians and the drug industry:

> "*I know that many doctors comply with the prescription guidelines suggested by the government or the drug industry. This platform is good for allowing me to collect as much drug information as I need to learn about food and drug interactions.*"

> "*I know that I can't take my hypertension drug with grapefruit. My doctors usually warn me about that and give me a list of* dos *and* don'ts*, but I didn't know that hypertension drugs can cause kidney failure…. I wish I had known about and been able use this platform a long, long time ago."*

> "*I like to see the analysis trend graphics from historical datasets that show the percentage of people who experienced the same side effects; it definitely motivates me to pay attention to my health.*"

One participant suggested that we add a voice search engine or else implement an intelligent wording process to solve their vision problems while typing from a keyboard.

Twelve patients agreed that now they pay even more attention to signals from their body (e.g., pain, dizziness, and other symptoms of disease) than they used to. Before the experiment, they usually took their drugs as prescribed without paying attention to other drugs that they might have been taking or to how certain foods or drinks might interrupt the effectiveness of their medications. Now they are more aware of the drugs they are taking, and they focus on the side effects they have or on other conditions that they notice themselves: this was our main purpose when we created the system, to train patients to be self-aware of the individual side effects of concurrently taking different drugs for different ailments or with certain foods known to interfere with the effectiveness of some types of drugs.

IV. CONCLUSION

In the experiment, we intended to provide a web-based portal to assist users to search the medication side-effect information using our datasets of medicine definitions, compounds, usage notices, side effects, and so on. The datasets contained and integrated medication information from pharmaceutical industry descriptions, and from pictures in a database provided by the Taiwan government. In addition, users can surf the Internet by typing in a drug name, and the platform will display search-engine results. This platform's datasets provide only basic drug information and historical data analysis graphics, but no information relevant to any particular clinic's treatments or disease-curing processes.

The dataset itself needs to be optimized and structured to make using it meaningful to patients. We are considering linking the chronic disease management function (for kidney disease and asthma, for example) to NHI databases containing historical data. Because evidence-based medicine has become a problem, due to drug industry-funded studies and to assertions by some researchers and government officials that some of the drug-testing articles published by famous biomedical journals are merely advertisements paid for by the pharmaceutical companies, we would like to provide historical drug records to allow Taiwanese patients to learn by and for themselves more about the medications they are prescribed and use.

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