

An Overview on Infrastructure of Digital Prescription and a Proposed Strategic Plan

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ABSTRACT

One of the most common and important therapeutic tools used by physicians is prescription. The use of digital systems in the health field has many benefits and significant impacts on the health system. One of these systems is digital prescription. In this article, First, we will review the existing infrastructure and work done in this area, and then with a new perspective on health issues, we will provide a new infrastructure.

Instead of introduction and use of a product or a system or statistical work, we aim to review fundamental issues in the field of health system and present a strategic plan in the field of medicine from the perspective of experts of medical informatics and IT specialists. In fact, we will present a strategic plan and will provide infrastructure in the health field. The infrastructure needed to create a digital system will be provided in order to increase productivity in various aspects of the health system; also, the interactions between different parts of this infrastructure will be discussed.

The advantages of this project will be reviewed from the perspective of various elements involved in the health system; these include patients, doctors, health system managers, pharmacies, pharmaceutical distribution companies, insurance office and other organizations, such as the environmental organizations, tax office, etc. and benefits of each one will be reviewed.

Keywords: Medication management, Digital system, Digital prescription, Prescribing, Infrastructure, Productivity

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Introduction

Prescription writing is one of the doctor's common and important therapeutic tools. For many years, the main choice of physicians to communicate with patients and decide about the drugs was prescribing. The text derived from this process is a good tool for pharmacists to distribute drugs and is a valuable resource for patients to take the drug (1-6). The exact observance of the standard principles of prescribing by your doctor increases the probability of correct choice of treatment and, therefore, improves the patient's health dramatically (7).

Institute of Medical Research in America released a report in 2006 and noted that the number of deaths from preventable medical errors in the United States of America is approximately 380,000. This institute in another estimate declares that these errors are about 450,000 annual estimates; it was also acknowledged that errors caused by prescription are one of the main types of medical errors (8). In another study, it was reported that

5.1 million people each year in the world are hurt because of prescription errors (3, 9).

Traditional Prescription (hardcopy) is done by pen and paper; therefore, there are many disadvantages, such as illegible prescription, unclear prescription directions, unclear abbreviations and doses, prescription fraud, incomplete medical records, and increased risks of human errors, etc. Several studies in the world have focused on avoiding errors of prescription and it has great impact on reducing the rate of medical errors (3, 4, 10-15).

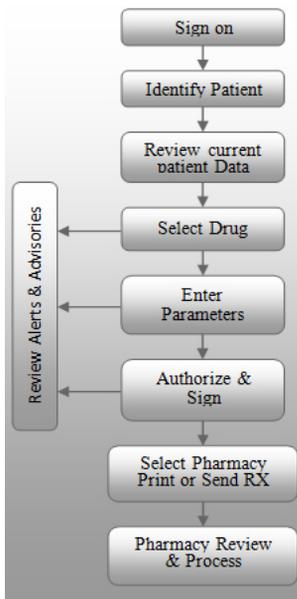
Vast improvement of information and communication technology (ICT) provides the appropriate opportunity to address the serious problems and major challenges induced by traditional methods of prescribing (16-18). Use of digital and electronic systems in the health system, such as an electronic prescription, in addition to reducing medical errors and improving the patients' safety, reduces the costs and increases the efficiency of managers' performance (19-22).

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Figure 1. The process of creating and managing e- prescription



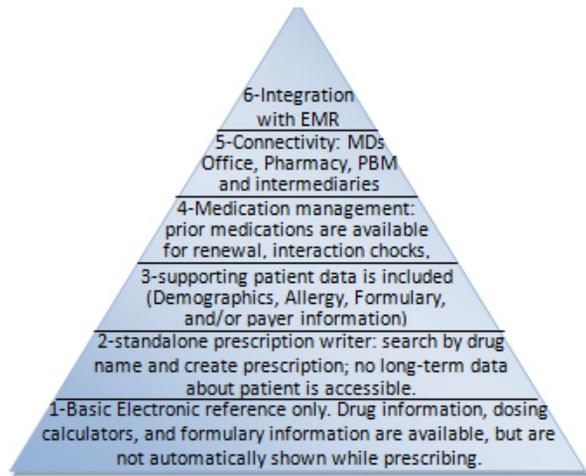
Electronic prescription writing is not using computer just for writing and storing prescription; rather, it is using computer and network infrastructure for entering data, changing, modifying and creating a prescription. This form of prescription is based on information and communication technology makes secure data exchange between all parts of the system (physicians, pharmacists, patients, insurance companies and etc).

In the process of electronic prescription, the prescriber generates electronic prescription and confirms it by electronic signature. Then certified prescription will be transmitted directly or indirectly to the system of supply and distribution with compliance of security and confidentiality of information and quickly it is sent to the pharmacy's distribution software of prescription; then, the insurance documents are electronically sent to the insurance company's server by pharmacy (18, 20, 22-25).

Figure 2. Electronic prescription system, like other medical information systems, has various development levels and Given the situation and ICT's infrastructure and also development rate of complementary and accessories in medical information systems, selection of the appropriate level of electronic prescription will be different. Obviously, high levels of the pyramid has more and better functionality (24-28).

The main advantages of this system are reduced prescription's errors, reduced side effects, reduced fake prescription, improved quality services, increased patient safety, improved management of drug distribution's cycle, capabilities of decision support systems, access to patient's medical information and history , reduced health care costs for all stakeholders (patients, service providers, insurance companies, administrators and policy makers), reform excess processes and repetitive work, simplified work processes for all stakeholders, etc. (24-32).

Figure 2. The development levels of e-prescription system



Proposed plan: The main reasons of this plan can be attention to care, respect the right of human life, and many of the project's economic advantages. This plan is kind of new issues in the field of health and treatment. We continue to investigate the proposed network and its infrastructure.

Different parts of the system are:

1. Server of Electronic Health Record
2. Server of Food and Drug Administration
3. Server of insurance companies
4. Server of banking network
5. Doctor at the office
6. Doctor at the hospital
7. Pharmacy

The existing supply and administration system has many problems in the field of management and its effect on patients and their families is evident. Sometimes these problems cause irreparable damage. For example, a patient who requires an urgent specific medicinal, his/ her family and relatives should find a pharmacy that has the medication required, and spend a lot of time leading to the loss of the patient. The rate of self-medication is one of other problems to be noted.

Food and Drug Information Server

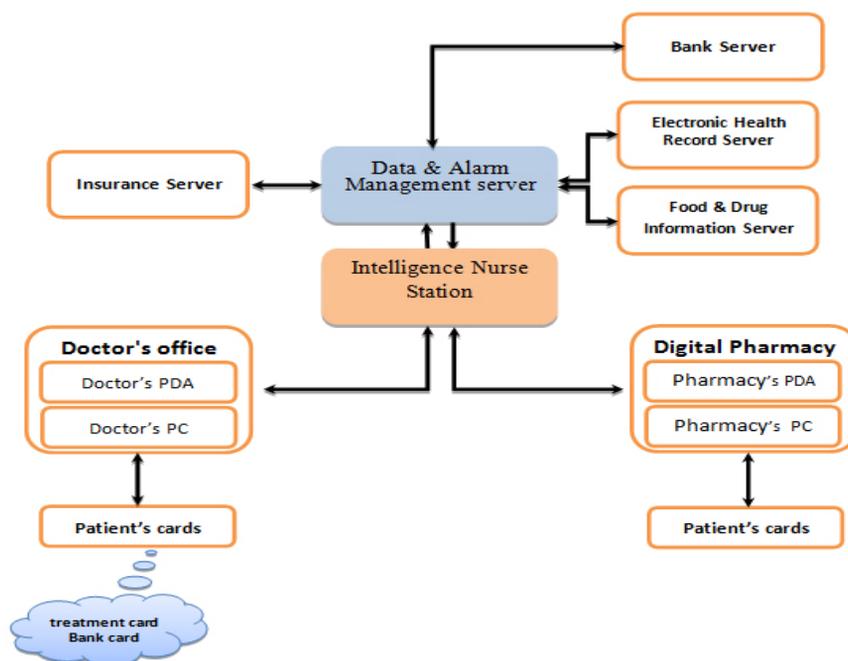
Due to the fact that half of all medical errors occur due to lack of information about the patient or medication. Through the use of this database, errors will be reduced and prescription's management and distribution of medication will be faster. Respect to confidentiality of patient's information in different subsection of Digitizing health system is essential.

Electronic Health Record's Server

Given the vital role of access to patient's records and information, with using of information will be obtained from connecting to the Electronic Health Records: management of patient's drug information and checking the patient's medication consumption and diagnosing the drug therapy problem. The Electronic Health Record's server has an important role in the network structure and in many cases this information and new information will be additional on this file.

Structure of the proposed network:

Figure 3. Structure of the proposed network



Insurance server

Access to patient's insurance information and this server will be used to check patient's insurance status from insurance companies so the insurance services and other related service will be clear.

Server of Banking network

This server is used to access information of banking and financial transactions related to all subsection of health domains.

The work process

Firstly, after the patient is visited by the physician in the hospital or doctor's office (shown in Figure 3 as Doctor's office), the patient's electronic prescription will be prepared and recorded.

Different stages and methods can be considered to prepare and complete the patient's electronic prescription but final decision will be made after negotiation with the doctor. For example, you could use handwriting recognition's software or physician could use at any stage a software application in order to do handwriting prescriptions and complete it by choosing different options.

The physician has a personal digital assistant (PDA) and office secretary or hospital's nurse in the nursing station has a personal computer (PC). It should be noted that in order to have quick access to infrastructure's health system and transfer information, PDA's role is very important role. Each PDA uses two methods to access the network:

- connecting to internal network through the wireless technology and local wired network.
- transferring information by using telecommunications and cellular network infrastructure; where it is not cellular coverage, it will use other communication methods, such as long-range wireless or satellite communications.

The process started by referring the patient to a physician (The patient had insurance card and bank card and was a member of banking network), after medical examination, the patient's insurance card will be read by card reader and

after the patient's authentication, the patient's information is transferred by using secure information transfer methods (Secure data transfer protocols such as SSL), and it will be received from server of Electronic Health Records. Given the patient's medical and medication's history (according to data from Electronic Health Records), the doctor decides to write a prescriptions. It should be noted that the relationship between the doctor's PDA and other parts of the network will be done through nursing stations. In other words, nursing station is a communication bridge between different parts of the network and main server.

According to applied policies, in order to contact doctor's office with the nursing station, city is divided into different sections and each office, based on its geographic area or other policy, is located in one of these areas in order to achieve network connectivity. The doctor writes prescriptions by using Personal Digital Assistant (PDA) and stylus (specific pen) and given to structure of doctor's software that will be installed on doctor's PDA (In order to obtain the doctor's consent, this software has been developed by interaction with physicians), so physicians could prescribe a medication based on their tastes. (Just like writing a ordinary handwriting prescriptions) or the doctor used medicinal groups and created grouping wherever he/she needed more information about a medicines (For example: we will see what is a new medication for this particular case and review the medication's features) connected to the server through PDA's software and check the medication information and other needed items. Finally, when the doctor wants to approve the prescriptions, the system checks this prescriptions using the information about the medication through the information server and if there are no any problems (For example, drug interactions, or changes with other medication based on medication's inventory (in order to Manage the medication's resources) prescriptions are approved and after the doctor's final confirmation, the prescription is sent to the secretary's PC

or nursing station's PC.

The doctor will be informed of the effects and side effects of prescriptive medication and this is another advantage of this system. Also, the doctor's information will be up to date and follows digital prescription issued by the doctor to find appropriate pharmacy. It is selected based on some priorities such as having all necessary medicines, distance to home or hospital, etc.

The second stage

The drug's server contains full statistics from the existing medication; it uses different priorities to select the pharmacy and the expiration date is one of the priorities. This tool is used to introduce the pharmacy whose drug's expiration time is closer in order to reduce the medication wastage and its economic losses. The system will list pharmacies based on the existing medication in the pharmacy and then select the closest pharmacy to the patient's location; after confirmation of this location by the patient, medication delivery is done at the selected location (For example, medication will be delivered to a hospital, doctor's office, or at home or work,) and the patient will pay for it by credit card (If the patient does not have a credit card or for any reason unable is to pay, the system will reserve it for a certain time, for example for 2 hours. so the patient goes to the pharmacy and pays cash for the medication).

The third stage

The pharmacy gets a prescription via digital prescription system and is informed about the payment through the bank's network; then, the pharmacy prepares the medication and sends it by mail or special courier who has the drug information.

It should be noted that the digital prescription is more than just an electronic prescription and creates communication between all the subsections related to the field of medication in the health system. This relationship has some advantages, as follows:

The general objectives

1. Increasing the efficiency and supervision of the Ministry of Health on the supply chain and distribution of drug in the country.
2. Managing Drug resources: Suggest changes drug with a similar sample with more abundant of drugs inventories (in distribution companies) are (in order to Manage of Drug resources).
3. Reducing the consumption of paper and environmental protection (electronic prescription and smart card instead of traditional methods).
4. Managing the orders and imported drugs (both of different levels of management and pharmacies).
5. Preventing the sale with higher prices.
6. Reducing the rate of intractable consumption of medication and selling without prescriptions
7. Counteracting against medication trafficking (In this plan prevention of abuse and withdrawal of expensive drugs from the cycle of drug distribution and entry into the trafficking cycle).
8. Reducing traffic and air pollution (medicines are delivered by the pharmacy's courier while the patient is at his/her office or hospital, or where that patient lives on place,).

Patient's Perspective

- Doctor's performance (for example: diagnosis of doctors who prescribe wrong drugs or ones with side effects).
- Saving time (essential medications are delivered by the pharmacy's courier at the patient's office or hospital, or patient's home).
- Reducing the cost of transportation to get medication (the required medicines will be delivered by pharmacy's courier at patient's office or hospital, or their home)
- Controlling the method of drug consumption automatically (patient's pharmaceutical record, dosage control, drug interactions, pharmaceutical allergies)
- Recording prescription's information in electronic database: physician's prescription is recorded in an electronic database (patient's record keeping for the next treatments and possibility of prosecution for medical errors).
- Avoiding repetitions, increasing efficiency and productivity of health care providers (the efficient use of medical staff and electronic services). Considering the fact that the patient's file is electronic, such prescriptions can be useful for both groups, patients and clinicians.
- Increasing the chances of life at critical moments: Preventing loss of golden time to provide the needed medications.

Doctor Perspectives

- Prescriptions based on electronic health records: The physician could better manage drug and treatment information by using drug consumption methods and correct diagnosis.
- Ranking physicians based on their successful resume and they are introduced to people in other areas.
- Automatic controlling of drug consumption (patient's pharmaceutical record, dosage control, drug interactions, pharmaceutical allergies)
- Sending requests directly to the clinic and getting its electronic reply.
- Sending prescriptions to the pharmacy and then receiving its electronic confirmation and tracking status of the patient's prescription.
- Updating the physician's drug information: Due to ongoing use of drug information server and interaction with this server, the physician will be notified about the side effects of prescriptive medication; therefore, they will be up to date.

Perspective of the pharmacy

- More income for active pharmacies: The pharmacy's ranking system is based on such criteria as the type and quality of services and customer orientation, etc. , finally more sales and more income to the pharmacy and healthy competition on providing better services to the customer.
- Unlimited sell: More income for active pharmacies: to local customers because the pharmacy's sales are done across the country.
- Fast and accurate informing directives and announcements
- Optimal management of medicines and timely supply of drugs according to need (based on the amount of drug stock in drugstores and stock of drug distribution companies and medication order by directors, even absence in the workplace (electronically regardless of physical location)).

- Reducing errors caused by incorrect interpretation of manual prescriptions.
- Managing pharmacy's inventory according to the specified patterns and determining the drug consumption.
- Billing of the pharmacy, preparing reports, such as list of drug delivery, pharmaceutical labels, etc.).
- Avoiding pharmacy's loss: drug's server has a full information about the drug; it has different priorities to choose the kind of the drug for using in prescription of the doctor. One of these priorities is expiration date; for example, this policy is used to reduce the pharmacy's loss by selecting the pharmacy (selected to provide the prescribed drug) based on closer product's expiration date.

Perspective of insurance companies

- Transparent and accurate monitoring of insurance companies on prescription that could prevent unreasonable and wrong prescription. You can prevent abuse of insurance company's resources, such as insurance booklet of another person; also, this system will prevent the possible abuse by doctors and pharmacies, for example:
 - The doctor writes a large number of subsidized drugs for a patient; then, this drug changes with another drug. In fact, it done by coordination with the physician and patient!
 - Doing legal action, i.e. if your doctor prescribed unnecessary drugs(error in detection and other abuses), he/she will be prosecuted.

Conclusion

By taking advantage of information technology, we could be use its benefits in order to achieve the objectives of the medical system and make a major change in traditional structure of the health system. According to various benefits of the proposed structure and using various resources (human resource, financial resource, etc.) in order to optimize the situation. Finally, we can be take effective steps towards the goals of economic strength.

Future Research

Given the advantages of using information technology in the health system, in order to optimize the use of resources in this area, first we need to create an appropriate IT infrastructure for future projects of health system. So after creating this infrastructure and implementing the project of digital prescription (network of Digital monitoring Drug Information), in the future studies projects such as smart hospital, smart pre-hospital emergency services are recommended to be implemented in order to expand and improve the quality of medical services in remote areas, etc.

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