

Improving Drug Prescription through Computer-Mediated Asynchronous Communication: A Case Study of Rural Hospitals in South Africa

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ABSTRACT This paper investigated how doctors in state owned hospitals in South Africa communicate with pharmacist inside and outside the hospital regarding drug prescription to patients. A case study approach was used. Nine participants were purposively selected from three rural communities in the North West Province. Data was collected using semi-structured open ended interview questions. The interviewees (3doctors, 3pharmacists and 3patients) were asked to tell in their own words the processes of prescribing medicine and transmitting of prescription forms to a pharmacist; the process of dispensing medication to patients; and how patients collect and administer the prescribed medication respectively. The findings revealed that paper based prescription were given to patients by the doctors to collect medication at any nearby pharmacy. However patients sometime did not present the paper prescription to the pharmacy for their medication because of their deteriorating health conditions. It was revealed that doctors receive no feedback after medication is dispensed to patients. The results led to a proposed computer-mediated asynchronous communication framework to provide systematic capturing, transferring, and effective communication between doctors and pharmacist to improve the process of drug prescription and dispensing to patients in rural hospitals.

INTRODUCTION

The World Health Organization (WHO), indicates that only about 50 percent of patients take their medicines as prescribed (WHO 2003). For this reason, WHO calls this “poor adherence rates” and it is a worldwide problem of striking magnitude and has published an evidence-based guide for health care providers, health care managers, and policymakers to improve strategies of medication adherence (Osterberg and Blaschke 2005). A recent survey Commissioned by the National Community Pharmacists Association (NCPA) also reported that nearly three out of every four American patients do not take their prescribed medicine as directed (National Community Pharmacists Association 2006). The report further indicated that one of the reasons for this is that nearly (31percent) of patients who received paper prescription do not file the prescription they were given. This problem of non-filing of paper prescription with a pharmacy for medication is exacerbated in developing countries like South Africa where distances between prescribers and dispensers play a major role. Patients who visit state owned hospitals in South Africa receive direct paper prescription which is intended to

be handed in at a pharmacy shop for medication but in most cases these prescription get lost before they are tendered in for collection and usage of the medicine. Again some of the paper prescriptions which are received by the pharmacist sometimes have alterations made to the prescription by the drug seekers or patients. Therefore the rationale behind this study is to exploit the potential use of electronic prescription (e-Prescription) based on computer-mediated asynchronous communication to alleviate the problem associated with paper based prescription. Electronic prescribing (e-prescribing) is defined as the use of computers to enter, modify, review, issue and/or transmit medication prescriptions (eHealth Initiative 2004). Studies have demonstrated that e-prescribing can improve patient safety, enhance office practice efficiencies, and reduce medical costs (Astrand et al. 2009). Again computer-mediated asynchronous communication which is an ICT component and medium for e-prescription has become the foremost tool to bridge the gap between doctors and pharmacists in exchanging professional ideas (Coleman et al. 2012). Despite the advantages of e-prescription through computer-mediated asynchronous communication, doctors in state owned hospitals and phar-

macists located inside and outside the hospitals do not use these tools to communicate drug prescription for their patients in South Africa.

Objective of the Study

This paper therefore investigated how doctors in state owned hospitals in South Africa communicate with pharmacist inside and outside the hospital regarding drug prescription for patients and based on the findings proposed a computer – mediated (e-prescription) framework to promote asynchronous and real time communication to improve efficiency in drug prescription.

The proceeding sections of this paper are presented as follows: literature and theoretical framework; methods, results and discussion, proposed computer-mediated (e-prescription) framework and finally the conclusion.

Literature and Theoretical Framework

Electronic prescribing (e-prescribing) is a computer-based electronic means of generating, transmitting and filling of a prescription, which takes the place of paper and faxed prescriptions (Electronic Prescribing 2008). E-prescribing allows a physician, nurse practitioner, or physician assistant to electronically transmit a new prescription or renewal authorization to a mail-order pharmacy. A more formal definition of e-prescribing is provided by the E-health Initiative and Center for Improving Medication Management (2008) as the transmission, through electronic media, a prescription or prescription-related information between a prescriber, dispenser, pharmacy benefit manager, or health plan, either directly or through an intermediary, including an e-prescribing network. It also includes, but is not limited to, two-way transmissions between the point of care and the dispenser. This definition encompasses clinical decision support to aid in safer, more informed prescribing through access to information on drug to drug interaction, drug- allergy interaction, patient medication history, pharmacy eligibility, formulary (which specifies a patient's drug coverage) and benefits information.

There are two types of e-prescribing systems; standalone systems and electronic health record (EHR) systems with an integrated e-prescrib-

ing module (E-health Initiative and Center for Improving Medication Management 2008). The standalone systems are not linked to EHR systems. This is less costly and less complex to implement, and can be implemented more quickly than an EHR system with an integrated e-prescribing module. On the other hand, an EHR system with an integrated e-prescribing module offers the advantage of having immediate electronic access to all patient data stored in the EHR system, including diagnoses, problem lists, clinical notes, laboratory and radiology results and orders. This adds to the clinicians ability to make the most informed medication choices for their patients. EHR systems may also offer a broader range of clinical decision support, including notification of needed screening tests, immunizations, etc. Physician practices are increasingly using e-prescribing within an EHR system, due to its more comprehensive functionality, which enables greater gains in quality and safety (E-health Initiative and Center for Improving Medication Management 2008).

E-prescribing functionality is not specific to any particular hardware or software. The clinical decision support functionality is available through full functioning of EHRs as well as stand-alone e-prescribing systems. In terms of hardware, physicians have implemented e-prescribing using hand-held devices, tablet personal computers, desktop personal computers, and other hardware available from technology vendors for their practices. From the above stated information, it is clear that e-prescribing uses many hardware device to support many dimensions of e-prescribing which can create value for the healthcare industry. These dimensions which are represented in Table 1 include, processing phases of e-prescription, key functions of innovations and description. The process phase of e-prescription emphasis on the actual prescription, transmission, dispensing, administering and monitoring of drugs. The key functions corresponding to each processing phases has been expanded in Table 1 to give much detail of what each process phase represents.

E-prescription which has many dimension as indicated in Table 1 can be operated synchronously or asynchronously. Synchronous communication is direct communication where the communicators are present at the same time. This includes, but is not limited to, a telephone con-

Table 1: Domains of e-prescribing

<i>Process phase</i>	<i>Key functions of innovations</i>	<i>Description</i>
<i>Prescription</i>	1 Patient identification	The prescription is linked to detailed patient demographic information including birth date, gender, and zip code.
	2 Current medication list	The prescriber can access medication history across providers from retail pharmacy transaction data, a health information exchange (HIE) initiative, or a combination of these.
	3 Medication selection	Medication can be selected from a list; options may be driven by diagnosis; accurate dosing; favorites lists.
	4 Safety alerts, clinical decision support	Can alert the prescriber when a medication is selected that is contraindicated or has a significant precaution based on the patient's allergies, current medications, medical conditions, body size, and/or laboratory test results
	5 Formulary alerts	Can alert the prescriber when medication is selected that is contraindicated by the patient's health benefit, e.g., non-preferred, prior authorization, step therapy, higher co-pay
	6 Renewal authorizations	Can alert the prescriber that a refill authorization is required and allows for generation of the renewal.
<i>Transmit</i>	7 Bidirectional electronic data interchange	Can communicate medication information among prescribers, dispensers, and payers, including new scripts, renewal authorizations, change requests, pharmacy benefit information, medication history, counseling results, etc.
<i>Dispense</i>	8 Pharmacist assessment and counseling	Assessment tools can identify patients likely to become none. adherent and encourage pharmacist counseling; makes a personal medication profile available to the patient
<i>Administer</i>	9 Patient education materials	Education materials can be made available about the condition, the therapy, and potential side effects
	10 Administration aids	Can provide graphical/visual medication administration support
	11 Collaborative medication management	Can connect physicians, other prescribers, pharmacists, health plan care coordinators, and individual care managers to support collaboration for management of medication therapy.
<i>Monitor</i>	12 Linkages to lab testing	Can remind prescribers and patients to obtain lab tests associated with the monitoring of certain medications
	13 Adherence alerts	Can use medication history to alert prescribers, pharmacists, and others that a patient is non-adherent
	14 Patient outreach	Can query patients regarding their experience with therapy, e.g., side effects, via interactive voice, e-mail, or text messaging
	15 Refill reminders	Can remind patients that medications need to be refilled
	16 Remote compliance monitoring	Can alert the patient, caregiver, or care monitor when administration of doses are late or missed

versation, a company board meeting, a chat room event and instant messaging. Synchronicity exists among individuals when they exhibit a shared pattern of coordinated synchronous behavior with a common focus (Harrison et al. 2003). Asynchronous communication on the other hand, does not require all parties involved in the communication to be present at the same time. Asynchronous computer-mediated communication is limited to communication where a network infrastructure capability of sustaining real time media connection is not cost-effective (Hersh et al. 2006). Asynchronous remote communication systems can be divided into the following: message, storage and discussion-centric systems. Message-centric systems are those which function like e-mails (Vassallo et

al. 2001). It enables doctors to send questions to specialist doctors and receive replies. They are easy to use but lack content management features that are useful to establish a community of communicators. Storage-centric systems are like Web or message-based picture archive communication systems that are often used in teleradiology (Jirotko et al. 2005). It adds basic search and storage capabilities. Discussion-centric systems implement the functionality of a typical Web-based bulletin-board system (incorporating messaging, discussion, and image storage facilities) which allows for two way communication. This paper, therefore, positions asynchronous computer-mediated communication between storage and discussion-centric system.

METHODS

The study was carried out in the North West Province in South Africa. Three community hospitals (Taung, Ganyesa and Bloemhof in the North West Province of South Africa) were purposefully selected. In addition three pharmacy shops situated outside the premises of each hospital but within the same community were selected. These hospitals were selected based on their geographical locations which span across the entire province and form part of the government owned institutions in South Africa. Again these pharmacy shops were selected because they were the only pharmacy shops which are situated in these three communities and are the only pharmacies where patients in each location go for their prescribed medicine.

The participants for the study were drawn from the entire population of doctors, pharmacist and patients in the three communities. A total of 9 participants were selected altogether. In describing population Polit and Beck (2008) indicate that it is the aggregate of cases having a common and designated criterion that is accessible as subjects for a study. A purposive sampling technique was used in selecting the participants. A doctor from each of these three hospitals was selected. In addition a pharmacist from each community pharmacy shop was also selected. Finally a patient was also selected from each community. These participants as indicated in Table 2 were selected by their professions as doctors (prescribers), and pharmacists (service providers) who were relevant to the study, while the patients were selected based on their regular visit to the hospital and the pharmacy shop. Three doctors, three pharmacist and three patients volunteered to participate in the study as indicated in Table 2.

Table 2: Participants who participated in the study (N=9)

Interviewers	Taung community	Ganyesa community	Bloemhof community
Doctors	1	1	1
Pharmacists	1	1	1
Patients	1	1	1
Total	3	3	3

Data was collected using semi-structured open ended interviews. The interviewees represented different roles ranging from doctors to pharmacists to patients. The interviewees were

categorized and asked to tell in their own words the following:

Doctors: the processes used in prescribing medicine for patient and methods of transmitting the medicine to the pharmacist inside and outside the hospital.

Pharmacists: the process of dispensing medication to patients and how feedback is given to the doctor.

Patients: the method of acquisition and administration of the medication prescribed by the doctors.

The interview lasted for one and a half hours with each interviewee and was audio-recorded and transcribed by the researcher. Integrity of data entry from the study was checked by another researcher. Transcripts were coded using Wolcott (1994) methods of case study analysis techniques. After the initial coding, broad categories were identified by searching for patterns in the participants' responses. The categories were doctor's methods of prescription, pharmacist process of dispensing and patient's methods of acquisition and administering of medication.

RESULTS AND DISCUSSION

The results and discussion are presented under the categories of doctor's methods of prescription, pharmacist process of dispensing medication and patient's methods of collection and administering of medication.

Doctor's Methods of Prescription

The findings revealed that patients are first identified by the doctors by the patients demographic information (date of birth gender and race) through their paper file which is presented to the doctor by an assistant nurse. They further check the patient's medical history and current medication being used by the patient. Doctors proceed to select new medication for the patient based on the new diagnosis of sickness of the patient. One doctor indicated that *"I check for drug –allergy, contradictions and potential side effect of the medicine before I prescribe. I therefore write this new medication and the dosage on a prescription forms which I hand it to the patient to go and collect the medication in the hospital pharmacy or go to the nearest pharmacy shop in the community to purchase it"*.

However, the handwritten prescription has a number of weaknesses; namely, varying readability and interpretation of the prescriber's handwriting, the risk of falsification, unidirectional communication with no feedback and the lack of easily understandable information for the patient.

The doctors further indicated that if prescription can be done electronically the following benefit can improve their work performance:

With the use of an electronic system, prescriptions will arrive at the pharmacy before the patient does, eliminating the need for the patient to drop off the prescription and wait for it to be filled. This is confirmed by Bond et al. (2012) who indicate that e-prescription provides convenience to the doctor, patient and pharmacist. E-prescribing if used by us (doctors) will streamline communication between physicians and pharmacies to renew prescriptions. For example, if the prescription has no more refills, the pharmacy will send an electronic renewal request to the doctor's computer system. The doctor's office can respond electronically to approve or deny the request quickly and easily. The patient is much less likely to have to wait for the pharmacist and physician to speak by phone. Furthermore this is confirmed by NIH (2006) which states that e-prescription streamline prescription renewal process.

Pharmacist Process of Dispensing Medication

The interviewed pharmacists indicated that when a patient arrives with a paper prescription from their doctor, the first thing was to check the doctors registration number, capture the demographic information of the patient on his computer system.

A pharmacist indicated that *"I use my computer system to find out if I have the drug on my shelf. If I have I then print the dosage of the medication, stick it on the medicine container and make it available to the patient. However, there is no means by which I can inform the prescribing doctor that I have dispense the medication to the patient"*.

The pharmacists further indicated that if e-prescription were to be utilized, the following benefits can be experienced:

By entering prescriptions electronically in a standard format, physicians eliminate many of

the opportunities for errors, such as illegible handwriting. Physicians are also more likely to have access to their patients' medication history information, which helps them make safer prescribing decisions and prevents prescribing medications that the patient is allergic to. This is confirmed by Adler (2009) who states that e-prescription is a quicker way of sending prescriptions to the patient's choice of pharmacy and promotes system checks for out-of-range dosing and duplicate drugs, resulting into safer methods of prescription. There is even more beneficial when e-prescribing is included in a full EHR that allows greater use of decision tools for the healthcare provider.

However the introduction of new technologies such as e-prescribing may create new errors, both systematic and non-systematic, in the prescribing and dispensing processes (Grimsom 2006; Koppel 2005). Stored e-prescription information may be used not only for filling the actual prescription but also for future clinical decision making and epidemiological research. Thus, it is vital to systematically monitor the quality of the electronic prescribing process (Astrand 2007).

Patient's Methods of Acquisition and Administering of Medication

The results revealed that patients are given paper prescription which they take to the nearest pharmacy for collection of medication. It was further revealed that patient sometimes do not present the prescription forms at the pharmacy for medication because of their deteriorating health conditions. This is confirmed by Lanseng and Andereassen (2007) who reiterate that a sick person has a reduced health condition and, therefore, spends more physical and mental energy relative to a healthy person when in need of medical care. This increases the input from the side of the sick person who is seeking medical care. However, Parasuraman (2002) indicates that reducing the input of a sick person through the use of, for instance, a computer mediated prescription system (for example, filled prescription forms electronically it at their convenience without any travel or waiting time at pharmacy) may improve patient perceived service quality, patient satisfaction and reduce providers' costs at the same time. From welfare perspective, injecting e-prescription into health-

care may prove to have a substantial potential benefit for users (for example, increased satisfaction) and providers' (for example, reduced costs or improved capacity).

Furthermore patients indicated that e-prescription can connect physicians, other prescribers, pharmacists, health plan care coordinators, and individual patients to support collaboration for management of medication. It can also remind prescribers and patients to obtain lab tests associated with the monitoring of certain medications.

The Need for Computer-mediated Asynchronous Communication Framework to E-prescription

Based on these findings the researcher proposes computer-mediated asynchronous communication framework (storage and discussion-centric system) to aid electronic prescription in rural communities in South Africa. The framework can be linked to EHR system or a stand-alone system.

When a patient consults a doctor in his consulting room within the hospital and the doctor sees the need for prescribed medication, the

doctor requests the patient's information and current medication from via the hospital's central database server. The key elements used to identify the patient on the system can include the patient's demographics or the patient's ID number. The doctor reviews the patient's current medication list and medication history, selects a drug and prescribes or adds a new medication. The doctor completes the prescription by signing the selected drug items electronically. He forwards it to the pharmacy department through the hospital's central database server. The pharmacist dispenses the medication to the patient and sends an alert to the doctor as a response to his message via the hospital's database server. The inclusion of an e-prescription solution was necessary because the findings indicate that the hospitals in rural areas need to reduce the long queues of patients at the pharmacy, prevent alterations made to the prescription by drug seeker and prevent errors in dispensing medication by pharmacists (Fig. 1).

CONCLUSION

Having reviewed doctor's methods of prescription, pharmacist process of dispensing

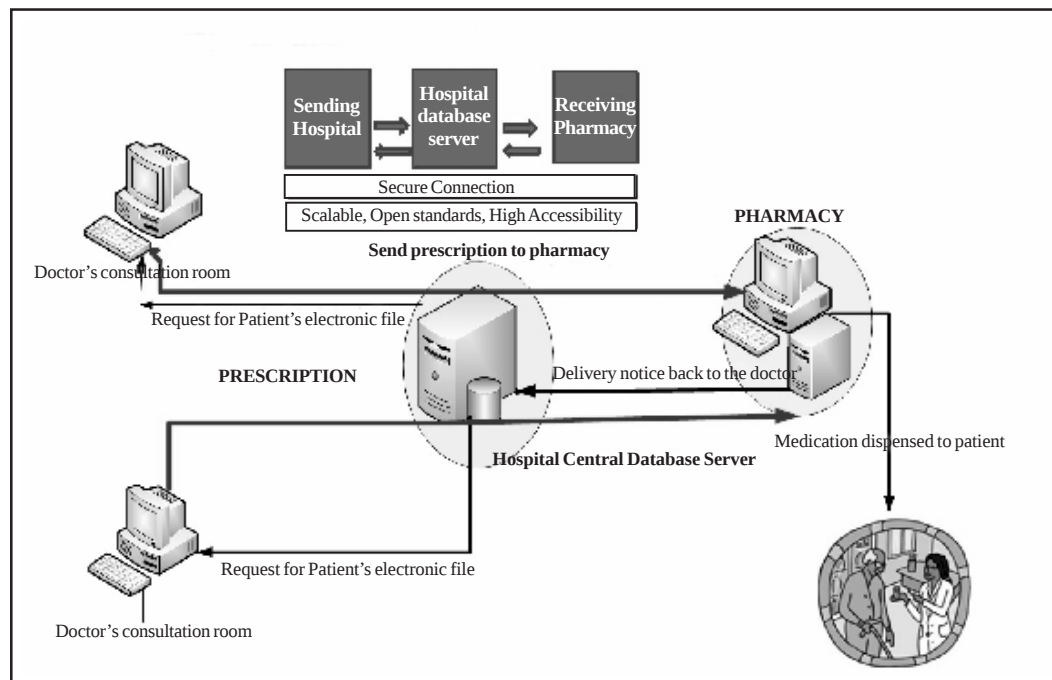


Fig. 1. Computer-mediated asynchronous communication framework

medication in South Africa, unpacked the concept of computer-mediated asynchronous communication in the context of e-prescription, investigated the methods of acquisition of prescribed medicine by patients, it was revealed that prescription by doctors in rural communities are paper based which patients are expected to collect and filled it at a nearby pharmacy for medication. Furthermore, it was revealed that when medication has been dispensed to the patients there is no feedback to the doctor for follow up on the patients and this result's into poor monitoring process by the hospitals. It was also evident from the findings that patients sometime do not present the prescription forms to the pharmacy for medication because of their deteriorating health conditions. Based on the findings this research paper proposed a computer-mediated asynchronous communication framework for rural hospitals to convert their paper prescription method to e-prescription. The proposed framework is to provide systematic capturing, transferring, and effective communication between doctors and pharmacist to improve the process of drug prescription and drug adherence rate by patients.

RECOMMENDATIONS

Based on the findings of this paper it is recommended that each state hospital in the North-West Province, keeps a central database server which keeps patients medication information and transfer this to pharmacies within and outside the hospital. Again doctors' consultation rooms must be equipped with computers and prescription software to assist them transmit request to pharmacist. It is further recommended that there should be integration of existing ICT applications in the hospitals, linkage of hospital ICT systems to outside pharmacy systems using HL7 messaging standard, installation of a broader internet bandwidth to improve internet connectivity and speed, and installation of a stand by generator for electricity in rural hospitals during power outages.

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