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Review Article

THE APPLICATION OF COMMUNICATION TECHNOLOGY IN HOSPITAL AND COMMUNITY PHARMACIES: A BRIEF REVIEW

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ABSTRACT

The use of communication technology has brought positive changes to the healthcare delivery system of today. Both healthcare professionals and patients have found a better option to access relevant health and drug information. The purpose of this review is to compile and evaluate all available investigations on the application of communication technology in hospital and community pharmacies. Pub Med, Medline and EBSCO host databases were searched using the key words: mobile phone, pharmacy and telecommunication, pharmacy and electronics, electronic record in pharmacy from the year 1994 until August 2014; whereby only full length English articles related to the review were included. Ten studies met all inclusion criteria comprising of 1124 respondents (age = 19-63, males=43%). Majority of the studies were cross-sectional in nature. Six utilized mobile phones as their means of communication of which majority (n=5) utilized text messages. Four utilized computer systems as their means of communication where they mostly work on drug-drug interaction software. Most of the reviewed studies demonstrated that incorporation of information technology in pharmaceutical care delivery and pharmacy training has improved patient satisfaction and produced better outcomes. However, several studies indicated that drug-drug interaction software had increased burden on the pharmacy staff and in some cases caused the distraction. Overall, there were positive reports on the use of communication technology which was found to help in improving pharmaceutical care.

Keywords: Smart phone as health monitoring tool, Pharmacists readiness

INTRODUCTION

New developments are frequently infiltrating our lives as technology improves every day. Ideally healthcare providers should make use of the latest technology in patient care to improve their services and to evade human errors. Properly used technology can enhance data collection, manage information and, ideally improve the overall quality of patient care. In pharmaceutical care, the uses of new technologies to reduce the number and severity of medication errors have been endorsed and in some cases, mandated [1].

Mobile computing and communication technology interventions for improving health care and health service outcomes referred to as M-health [2] are used nowadays in a broad range of data collection and information transmission to support health behavior change. Historically, mobile health professionals such as physicians and clinical pharmacist have carried numeric pagers; however, the unidirectional nature of these devices and lack of information content impede timely communication between healthcare providers [3]. Another mobile device that has been used recently by health providers is the personal digital assistant (PDA), which can improve access, to medical information but does not have the communication function, and therefore is likely inferior to currently available smart phones [3]. Many practicalities of the healthcare system can be made automatic and easier for both patients and healthcare staff by using mobile phones. It has been suggested that technologies such as electronic Patient Medication Record (ePMR) systems can help to prevent medication error, reduce potentially inappropriate prescribing and prevent harm to patients [4]. M-health services like messaging can promote safe medication use by improving the knowledge of the pharmacist and patients, pharmacist – patient interaction, and pharmaceutical care [5].

The term patient medication record relates solely to the record of the prescription dispensed to a patient by an individual pharmacy and covers items dispensed from National Health Service (NHS) prescriptions, private prescriptions and very occasionally, over-the-counter medications. The record may be paper-based or kept in electronic format on electronic Patient Medication Record (ePMR) system. These systems can be found in all primary and secondary care pharmacies in the UK. Other names used for ePMR include pharmacy computer system, pharmacy information system, and pharmacy information management system [4]. Standard operating procedure in the dispensing of medication by the Malaysian Community Pharmacist Association [6] proposed that every community pharmacy be equipped with a software program to assist documentation of all the patient medication that can be printed as a permanent record to be kept for minimum of two years. Currently there is very little information on the availability of printed or electronic record keeping of patient profiles within community pharmacies in Malaysia although a study has found that there is low prevalence and usage of electronic references in community pharmacies [7]. There is a need to address this issue in order to improve pharmaceutical care in the community pharmacy setting and to ensure continuity of care among health care providers.

In Malaysia, there is currently no dispensing separation as the GPs are given the legal right of dispensing [8]. The 1952 Poison Act 23 [9] and other laws in place granted the right for registered GPs practicing in private clinics to prescribe and dispense medications in their clinics. As a result, for many years most community pharmacies (CP) are focused on the sale and supply of non-prescription and healthcare products. Consequently, much patient information is lost as a result of patient visiting different GP clinics and pharmacies. This leads to several problems such as repeated treatment, delayed diagnosis, and financial loss to patients. It has been suggested that electronic patient health record (ePHR) system can help to prevent medication errors, reduce potentially inappropriate prescribing and prevent harm to patients [4].

Our paper reviews the current state-of-the-art on the use of technology in community and hospital pharmacies in general, without emphasizing merely in any particular area or the mode of communication used

This review was conducted as an Internet database search in August 2014. A search of Pub Med, Medline and EBSCO host databases was carried out using the keywords: mobile phone, pharmacy and telecommunication, pharmacy and electronics, electronic record in the pharmacy. In addition, reference lists from the papers that were found in the database search were further examined. To ensure that all the relevant papers were included, the databases search described above was also repeated in the databases of these journals. All the relevant papers were reviewed, and those suiting to the scope of this article were selected. The inclusion criteria for the papers selected for the study were the following; 1) publication year: 1994 or later, 2) investigations involving applications of technology in pharmacy practice.

In addition to these reviewed papers, several other studies from other journals and conferences that bring additional viewpoints and used cases for this article were included. Many of these additional articles were found from the reference list of the reviewed papers.

Demographic information for all participants in the selected studies was summarized according to their age, gender, duration of the study. In addition, the following key information was extracted from each study; first author, publication year, country of the study, mode of communication used, sample size, setting, aims of the study and primary outcomes. For details, see tables 1 and 2.

Table 1: An overview of demography of the respondents enrolled in the reviewed studies

Author (year)	Country	Age of respondents (mean or range)	Gender of respondents	Duration of study	Ref. No
Murphy et al. (2004)	USA	NA	Male=5 Female=4	7 days	10
Abarca et al. (2006)	USA	37	NA	NA	11
Indermitte et al. 2007	Switzerland	63	Male=276 Female=324	4 weeks	12
Mao, et al. (2008)	China	46	Male=57 Female=43	10 days/patient	13
Adedeji, et al. (2011)	Nigeria	NA	Male=26 Female=84	24 days	14
Pop-Eleches et al. (2011)	Kenya	NA	NA	48 weeks	15
Al-Dhawailie, et al. (2013)	Saudi Arabia	NA	Male=102 Female=148	6 weeks	1
Usir et al.(2013)	Malaysia	NA	NA	3 months	7
Sankaranarayan & Sallach, (2014)	USA	19-40	Male=3 Female=21	3 months	5
Toh, et al. (2014)	Singapore	NA	Male=12 Female=19	3 months	16

NA = not available

From the year 1994 until August 2014, a total of ten articles that met the inclusion criteria were found comprising 1124 respondents (age = 19-63, males=43%). Three of the studies were carried out in the USA, one each from China, Kenya, Nigeria, Saudi Arabia, Singapore, Malaysia, and Switzerland. Three of the investigations were carried out in hospital pharmacies, four in community pharmacies, one in both hospital and community settings and one in a school. Only one study [15] was a randomized controlled trial. Majority were cross-sectional in nature

Of the ten studies, six used mobile phone as their means of communication of which majority (n=5) utilized text messages [1, 5, 13, 15, 16] and one utilized phone call [14]. Four utilized computer systems as their means of communication [7, 10, 11, and 12].

Mobile phone as a communication tool

Mao et al., [13] attempted to improve medication adherence and safety through individualized pharmaceutical care. In their study, a mobile pharmacy service system was developed (MPSS) to deliver individualized pharmaceutical care via text messages. The MPSS is an SMS-base system that can run on a computer and facilitate pharmaceutical care by sending mobile phone text message to patients. The text messages were: reminders about their medication, practical information about medicines (such as information about method of administration), and information about adverse drug reactions. In a three-month trial in a general hospital in China, 100 patients were provided with pharmaceutical care using the MPSS for an average of 3.5 medicines per patient for 12 days each. A survey was then conducted which found that most patients were satisfied with the pharmaceutical care provided by MPSS through text message. Similarly, in a randomized control trial, Pop-Eleches et al, [15] tested the efficiency of short message service (SMS) reminders on adherence to antiretroviral therapy (ART) among patients attending a rural clinic in Kenya. Four hundred and thirty-one adult patients who had initiated ART within three months were enrolled and randomly assigned to a control or one of the four intervention groups. Patients in the intervention groups received SMS reminder that were either short or long and sent at daily or weekly frequency. Adherence was measured using the medication event monitoring system (MEMS).

Table 2: Application of communication technology in hospital and community pharmacies, a review from 1994 to 2014

Author (Year)	Study design	Settings	Sample (n)	Country	Mode of Comm. Used	Aim(s)	Main outcome(s)	Comment(s)	Ref. No
Murphy et al. (2004)	Cross-sectional	Community pharmacies	9 pharmacists	USA	Computer system for drug-drug interaction alert	To determine community pharmacists' responses to drug-drug interaction alerts	Drug-drug interaction alert decreased pharmacists' efficiency by alerting mostly interactions of less clinical significance.	May lead to pharmacist overriding clinically important interactions.	10
Abarca et al. (2006)	Cross-sectional	Community pharmacies and hospital pharmacies	37 unique drug pairs for drug-drug interaction	USA	Drug-drug interaction software in a computer system	To evaluate the performance of drug-drug interaction (DDI) screening software in identifying select clinically significant DDIs.	Improved performance of community pharmacy computer system in identifying DDI. Significant variation in the performance of hospital pharmacy computer systems in identifying DDIs.	Did not attempt to link the pharmacy system with actual patient outcome.	11
Indermitte et al. 2007	Cross-sectional	Community	600 out patients	Switzerland	Drug-drug interaction	To explore the handling of drug-	Decreased work efficiency as a result of interaction	Did not assess clinical outcomes	12

		pharmacies	data		alert using computer system	interaction in community pharmacies	alerts of less clinical importance.	on patients' level. Clinically important interactions may be ignored.	
Mao, et al. (2008)	Longitudinal	Hospital	100 patients	China	Mobile phone text messaging.	To improve medication compliance and safety through individuali-zed pharmaceutical care	Increased patient satisfaction Decreased workload. Increased pharmacist-patient interaction. Improved the effect and safety of medication	A relatively comprehensive study compared to other reviewed studies.	13
Adedeji, et al. (2011)	Cross-sectional	Community pharmacies	100 patients	Nigeria	Mobile phone calls (toll-free)	To provide "proof of principle" of an innovative approach to pharmacovigilance.	Facilitation of pharmacovigilance and follow- up of responses to medicines in a resource -limited setting.	ADR was observed for only four days. Therefore, any ADR beyond that was not observed.	14
Pop-Eleches et al. (2011)	Randomized Controlled Trial.	Hospital	431 patients attending rural clinic.	Kenya	Mobile phone	To test the efficacy of short message service (SMS) reminders on adherence to antiretroviral therapy (ART).	SMS is an important tool to achieve optimal treatment adherence in resource limited settings.	The service sent only 'one way' messages to which respondents could not respond.	15
Al-Dhawailie, et al. (2013)	Cross-sectional	Hospital	250 patients	Saudi Arabia	Mobile phone	To measure the patient acceptance rate of using their personal phone to receive pharmaceutical care.	97.2% of the participants accepted the idea of using their mobile phone in pharmaceutical care.	May not reflect the views of patients with chronic diseases as this was conducted on the general patient population.	1
Usir et al.(2013)	Cross-sectional	Community pharmacies	93 pharmacies	Malaysia	-	To determine availability and usage of printed and electronic references To determine the availability of Patient medication record in community pharmacies	Rather low prevalence and usage of electronic references in community pharmacies.	Only a survey-based study without any intervention.	7
Sankaranarayan&Sallach, (2014)	Cross-sectional	Community pharmacies	24 patients	USA	Mobile phone	To determine rural patients' access to mobile phone and Their willingness to receive m-health services	95% of the patients have access to mobile phones and were willing to receive m-health technology services.	The age range in the study (19-40) was wide. Therefore covered both young and elderly views (an advantage).	5
Toh, et al. (2014)	Cross-sectional	School	31 final year students	Singapore	Mobile app	To enhance pharmacy practice education through mobile app.	Visual patient record mobile app improved learning of pharmacy practice.	The app was developed on Android platform; thus, cannot work on other platforms such as Apple's iOS (operating system) that will limit access.	16

The participants received a new medication in the MEMS bottle. MEMS adherence was calculated as the number of actual bottle openings divided by the number of prescribed bottled openings for the period. Because all patients were prescribed twice-daily ART, the maximum number of the opening was set to be equal to two so that MEMS adherence was not inflated by extra cap openings. The primary outcome was whether adherence exceeded 90% during each 12-week period of analysis and the 48-week study period. Secondary outcome was whether there were treatment interruptions lasting at least 48h. 53% of participants receiving weekly SMS reminders achieved an adherence of at least 90% during the 48 weeks of the study compared to 40% of participants in the control group. Also, participants in the group receiving reminders were significantly less (81%) likely to experience interruption exceeding 48h during 48 weeks follow-up than those in the control group.

Similarly, 97.2% of patients that participated in a pilot study conducted in a King Khalid University Hospital in Riyadh, Saudi Arabia accepted the idea of pharmaceutical care through mobile phone text messaging system. In the study, Al-Dhawaillie et al, [1] structured a questionnaire in Arabic language which included items such as demography, preferred language, previous use of mobile phone, agreement to give mobile phone to pharmaceutical service department, agreement to use the service, acceptance of the idea, expected pharmaceutical service and information needed by patients. Text messages were phrased as statements such as "[Hi (patient's name). Here's your treatment team want to remind you that the dose of your (medicine's name) is (dose) to be taken (no. of doses) daily]" and "[Hi, (patient's name). Here's your treatment team want to remind you that if you experience (side effect), don't worry, it's caused by the medicine. Inform us if you experience something else]". Majority of the participants (74%) had never used a mobile phone in healthcare previously. Most participants (98.7%) were looking for information about medicine such as the proper dose, treatment duration, the proper way to use the medicine and possible side effect.

Sankaranarayanan and Sallach, [5] recently explored patient-centered demand for mobile phone-based health [mobile health (m-health)] services in the rural United States of America by documenting rural patients' access to mobile phone and their willingness to receive m-health services. A cross-sectional study was conducted, and information such as demography, health status, mobile phone access and their willingness to received m-health was collected. Majority (75%) of the patients reported that m-health services were important to them, and approximately 95% have access to mobile phone and were willing to receive m-health services. A similar study conducted in Nigeria by Adedeji et al. [14] aimed to provide a proof of an innovative approach to pharmacovigilance. Purchase of medicines was actively monitored for 28 days in three community pharmacies and four patents and proprietary medicine store (PPMS) in the community. Information on an experience of ADR was obtained by telephone from 100 volunteers who purchased anti-malarial drug during the 28-days period. Out of the total drugs purchased, 12.4% were completed courses of anti-malaria. Response to mobile phone monitoring of ADR was 57% in the first 24h after purchase and decreased to 33% by day 4. A member of the research team responded to inquiries by phone from patients and categorized the complaint as an adverse drug reaction (ADR).

In Singapore, Toh et al, [12] developed a prototype virtual patient record (VPR) mobile app on two Samsung Galaxy Tab tablets to educate students on the types of patient health information available from electronic health records (EHRs). The app had four features; 'PHR', 'Case Questions' 'Statutes' and 'Useful Links. 'PHR' contained fictional patient records containing personal health information while 'Case Question' feature contained clinical cases scenarios. Web-links to government statutes of Singapore (such as Medicine Act, Poison Act) were built in the 'Statutes' feature. Web-links to other professional websites (e. g. Singapore Pharmacy Council, Pharmaceutical Society of Singapore) was incorporated into the 'Useful Links' feature. In the cross-sectional pilot study, students used the app to solve counseling case scenarios and there-after an online survey was conducted using 14-item questionnaire to determine their perceptions regarding the app's usefulness and, its relevance as an EHR simulation tool.

Most students felt that the app features were understandable and self-explanatory (96.7%). Majority agreed that 'PHR' (100%) and 'Case Question' (83.9%) were the most useful features and (90.3%) found the app use as a teaching aid.

Computer systems as service enhancers

Three of the studies reviewed aimed to find out the effect of drug-drug interaction (DDI) software on pharmaceutical care and attitude of pharmacists toward it. Abarca et al., [11] evaluated the performance of drug-drug interaction screening software in identifying select clinically significant DDIs in pharmacy computer systems in community and hospital pharmacies. Eight community pharmacies and five hospital pharmacies participated in the study. To test the performance of each of the systems used by the pharmacies, 25 medications were used to create six mock patients profiles containing 37 drug-drug pairs, 16 of which are clinically meaningful DDIs that posed the risk to patient safety. Each drug profile was entered into the computer pharmacy system, and the system response in terms of presence or absence of a DDI alert was recorded for each drug pair. The median sensitivity specificity for community pharmacies was 0.88 and 0.91 respectively compared to those of hospital pharmacies at 0.38 and 0.95 respectively. In a similar research conducted in Switzerland, pharmacist overrode a substantial proportion of drug-drug interaction alert of minor or moderate severity by ignoring them or by programming the system to only flag drug interaction of potentially high severity [12]. In this study, data were collected by 15 trained pharmacy students in 15 Swiss community pharmacies. The medication history and the drug interaction alerts of 600 patients who had ≥2 drugs on prescription were assessed, and pharmacist in charge was interviewed about their management of drug interaction alerts. The median frequency of drug interaction alert increased with decreasing default severity level from 0.5 to 40, respectively, to 76 per 40 patients visit to the pharmacy. Because of this default setting, 277(35.2%) of 787 potential drug interaction on new or repeated prescriptions were overridden by the computer systems. A research by Murphy et al., [10] found similar result and concluded that a substantial amount of the time of the pharmacist working in a community pharmacy was spent reacting to DDI alerts, most of which are overridden.

U sir et al., [7] aimed to determine the availability and use of printed and electronic references and Patient Medication Record in community pharmacies around Malaysia. In the three-month cross-sectional study, 93 pharmacies participated and structured questionnaires were mailed to them. It was found out that more than half (59.1%) of the pharmacist kept their Patient Medication Record profiles, of which 49.1% storing it in paper form, 41.8% electronically and 9.1% in both printed and electronic version. Almost all the pharmacies (96.8%) have at least Monthly Index of Medical Specialties (MIMS) while 78.5% kept at least the MIMS ANNUAL in their stores.

In this article, we have reviewed the work made in the use of technology for pharmaceutical care in hospital and community pharmacies. Communication technology can fulfill many of the requirements and needs of healthcare, such as providing a platform for reminder system for patients [1, 15, and 13]. Ten studies were identified, and each of these studies showed the usage of technology in the pharmacy. Contrary to our expectation, half of the studies were conducted in developing countries. This suggested that there is high mobile phone penetration in developing countries that has the potential for improving healthcare delivery. It has been estimated that over two-thirds of the population in Africa is covered by a mobile network with a penetration rate of 50%, reaching over half a billion mobile phone subscribers across the continent [17]. Majority of the studies were also cross-sectional design. Cross-sectional studies are quick easy, and cheap to perform. They are often based on a questionnaire survey. There will be no loss to follow-up because participants are involved only once. However, a cross-sectional study may be prone to non-response bias if participants who consent to take part in the study differ from those who do not, resulting in a sample that is not representative of the population. More randomized control trial studies should be conducted as its outcome are more reliable scientifically [18].

The study by Adedeji et al., [14] found that the availability of a toll-free mobile phone line facilitated pharmacovigilance to medicines in a resource-poor setting. Monitoring of adverse drug reactions is an important component of the healthcare system. The challenges of pharmacovigilance in developing countries are not unconnected to the poor reporting structures and lack of motivation to report. Findings from the study showed that mobile phones offered a practical means of reporting ADR. This agreed with the findings of Pop-Eleches et al. 2011 [15] that SMS is an important tool to achieve optimal treatment. It provided evidence of the clearly beneficial effect of mobile phone technology for HIV/AIDS care delivery.

This could also be implemented in other healthcare delivery system other than HIV/AIDS treatment which may help to decrease missed appointments, improve adherence and reduce the emergence of drug resistance. It may also help to improve the effect and safety of medication, increase pharmacist-patient interaction and increase patients satisfaction as indicated by the research conducted in a China hospital by Mao et al. [13] Al-Dhawali et al, [1] demonstrated patients' willingness to use their mobile phone to receive pharmaceutical care. There are many reports of the utilization of the mobile phone short messages services (SMS) in patient care. Wie et al. [19] presented a literature review including 24 articles on the use of text messages for clinical and healthy behavior interventions in general healthcare settings. Joo et al.[20] used mobile phones to deliver short messages about diet, exercise and behavior modification and found that SMS messaging may be an effective method of behavior modification in weight control of an anti-obesity health education program.

Communication technology is also employed in health education as Toh et al., [16] developed a teaching aid in form of mobile apps. Effective patient management in clinical practice relies upon individual's competency in his/her practical skills. Thus, early exposure will ease students' transition to working life as healthcare professionals.

Three of the studies reviewed found that use of drug-drug interaction software improved pharmaceutical care services and overall patients' outcome. However, drug-drug interaction of minor potential severity serves as a distraction to pharmacists as such decreases their work efficiency, for that, pharmacists override such alerts [10, 11, and 12]. This could result in the pharmacist ignoring clinically important alerts [16, 21, and 22] which may lead to fatal consequences.

In all the studies above, emphasis was made on improving pharmaceutical care through healthcare providers without paying much attention to improving developing it through empowering the patients themselves. Empowering patients with his/her medication history can lead to better record keeping that will go a long way in improving pharmaceutical care. This can help prevent medication errors, reduce potentially inappropriate prescribing and prevent harm to patients as suggested by Ojeleye et al.[4].

One of the strengths of this systemic review is its rigorousness. It is also one of the first in the field, to the best of our knowledge that examines the application of communication technology in hospital and community pharmacy.

Some limitations required mentioning, however. Even though a thorough search strategy was employed, we could not be certain that all relevant studies have been included because other studies could be reported in languages other than English. This was because the primary databases used for literature search such as Medline; EBSCO host contains predominantly English language; hence articles in other languages might have been overlooked.

From the evidence gathered, the use of communications technology in pharmaceutical care seems to hold beneficial potential as an alternative way of delivering pharmaceutical care to patients. Overall, the positive reports meant that the incorporation of such technology into healthcare delivery, education and promotion systems could be further expanded to include patient self-empowerment for better monitoring and quality of care.

CONFLICT OF INTERESTS

Declared None

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