Medication error: The role of health care professionals, sources of error and prevention strategies

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ABSTRACT

The principal goal of medicine is to achieve positive therapeutic outcome while carefully minimizing patient risk. However, with the advancement made in the technology of drug discovery and formulation new medicines are flooding to the drug-market. Although newly launched medicines are opening lot more avenues and opportunities for patient care but also harboring new hazards. Medication errors (MEs) are common in health care system all over world. These errors are more dangerous especially in developing countries were patients' right is not well protected. It contributes significantly to drug-related complications which range from mild damage to more severe event leading to hospitalization. Various health care professionals' attitudes as well as system failure contribute to MEs. It has become necessary for every health care professional to understand the nature and sources of MEs and try to find solution. Sources of MEs are multi-factorials and multi-disciplinary that require careful detection, assessment and intervention. Several MEs preventive strategies were identified which if properly implemented will significantly improve health care delivery services. The purpose of this work was to highlight the role of health care professionals in MEs; identify the common sources of MEs and discuss the proper MEs preventive strategies.

Keywords: Medication-Error, Sources of Error, Prevention-Strategy.
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INTRODUCTION

Knowledge of MEs is crucial to every health care professional. It was established that committing error is human nature. Therefore, awareness on ME will significantly improve the quality of patient care. However, ME can be potentially harmful and may lead to hospitalization. Therefore, it is imperative for all stake-holders like drug-manufacturers, medical-practitioners, patients and regulatory authorities to have a clear idea on MEs in order to take pre-emptive measures and ensure safety for patients [1]. Medical-practitioners with adequate knowledge of MEs have a better concept of avoiding it and increase treatment competence. To understand MEs and initiate preventive strategies, modern classification of MEs has become necessary. It is important to distinguish between MEs and its subset prescription errors (PEs) [1-2]. MEs errors are commonly committed by three main health care professionals such as doctors, pharmacist and nurses. It is necessary to identify the type of error, its source and the health care professional involved for appropriate resolution [1]. Medication-error can occur at any stage from diagnosis to discharge. The three major stages of patient-care are prescription, dispensing and administration. Prescription-error is considered the most important because poor-prescription can lead to dispensing and administration error. Prescriber must have detail information of patient disease condition; medication history with drug-allergy [3-4]. A lot of factors contributed to MEs which are individual factors include: lack of adequate knowledge of medications;

lack of understanding MEs; not adhering to work procedures; fatigue; hurry. System failure include inadequate staffs; poor working environment; insufficient stock; and use of complex procedure [5-7]. It is generally recommended that clinic, pharmacy and ward environment be well equipped and made conducive for smooth and effective patient care.

Study has shown that prescription-error is the major source of MEs which account for 70% of the error detected; also 4 in every 1000 PEs identified in teaching hospital had potential to cause adverse drug reactions (ADRs) [3]. PEs often considered as preventable source of treatment failure and increase cost [8]. PEs can be committed by medical-doctors of all level, but it is more common with juniors which may vary from 2 to 514 errors per 1000 prescription [5]. As a part of quality assurance procedure, pharmacist should detect and address all PEs. Pharmacist is also responsible for prevention of administration errors with proper dispensing. This can be achieved through effective communication with nurses and proper patient counseling [6]. It is important to extend the knowledge and intervention with regards to MEs to community practice because errors also exist in community. MEs causes injury in 1.5 million patients and increases the cost of health care in USA by 3.5 billion US $ every year [9]. Research have shown that about 44,000 to 98,000 patients lost their life every year due to ADRs, out of these more than 7,000 was attributed to MEs [10].

Definitions of Terms
i. Underreporting of MEs: MEs have suffered serious problem of underreporting over years; research have shown that 95% of MEs were not reported due to fear of a number of consequences [11]. Majority of health care professional has a preconceived idea that reporting will not add any benefit to the patient [12]. Similarly, medical-practitioners believe reporting of MEs will tarnish their image and result in patient loss of confidence, there was also fear of punishment from superiors or termination of appointment [12]. Review carried out in Iran reported that reasons for underreporting MEs includes personal fears, administrative barriers, and complexity of the reporting process [13]. Similarly, 100% of studies stated that ignoring to report was the most important barrier. Nursing students revealed that fear of decreasing evaluation scores had the highest importance. Additionally, authorities mostly focused on individual fault rather than system failure [13]. The aim of this study is to highlight the role of health care professionals in MEs, identify the common sources of MEs, and discuss the proper MEs preventive strategies.

ii. Medication: Refers to medicinal product which possess biological activity, alone or containing additives, it may be active drug molecule or pro-drug which act only when converted to active metabolite, it may also be cellular elements [1]. Several compounds and mixtures are considered as medicine including diagnostic media, blood products, and viruses for gene therapy, stereoisomers, as well as chemical and biological contaminants [1]. However, medications do not include the use of chemicals for non-diagnostic purposes e.g. use of phenylephrine to study baroreceptors reflexes in physiological and pharmacological experiments [1].

iii. Prescription: Is a written order containing the detail explanation of the medicine such as dosage form, dose, frequency of administration, route of administration, and duration of treatment; also details of patient, hospital, name and signature of the prescriber [1].

iv. Error: Error can be described as mistake that occur due to ignorance, hurry, complacency or an over sight in communication, writing, and calculation during treatment process; it also involves use of wrong procedure or incomplete plans to achieve particular treatment objectives [1].

v. MEs: MEs can be described as mistakes that occur during manufacturing, compounding, prescribing, dispensing or administration of medicine and related products which has potential to harm the patient [1, 4, 14-15]. MEs can occur during any of the routine treatment stages from diagnoses up to the time the patient is discharged; therefore, it is important to identify the root cause of MEs in order to prevent it.

Modern Classification of MEs: In order to properly classify MEs, several factors need to be taken into consideration. Methods used in categorizing MEs include contextual, modal and psychological classification [1, 16]. Contextual classification categorizes MEs according to the type of medicine, specific time it occurred, patient involved and place where it occurred. Modal classification concentrates on the manner and means through which MEs occurred. Finally psychological classification focused on the type of patients involved and tries to establish the event leading to MEs [1]. Generally, six type of medication occur in practice including prescribing fault, PEs, transcription error, dispensing error, administration error and across setting error [16-17]. However, this article limits its scope to three major types of MEs namely: PEs, dispensing error and drug administration error that involves directly the role of major health care professionals.

The Role of Health Care Professionals

i. The Role of Prescribers in PEs: PEs occur when prescribers' written order is not balanced, incomplete or contains incorrect details normally expected to be clearly written by the prescriber; it may involve inappropriate choice of medication, wrong dosage or dosage regiment which can potentially injure the patient [18]. "PEs occurs when as a result of a prescribing decision or prescription writing process, there is an unintentional significant (1) reduction in the probability of treatment being timely and effective or (2) increase in the risk of harm" [2, 18]. PEs usually occur in two major processes involved in prescribing medicine, first is decision making in choosing the best drugs for the patient, here the prescriber need to check patient overall history and thorough physical examinations; failure to do that may lead to irrational prescribing [1]. Secondly, during writing, prescriber may come up with the best drug but presented it in an inappropriate manner; make an omission, repetition or substitute the intended drug; use complex abbreviations e.g. SC (subcutaneous) which may be mistaken for SL (sublingual); omission of zero before decimal also contribute to PEs (e.g. .1mg may be mistaken for 1mg) [9]. According to WHO, hurry is another cause of PEs, most of the doctors in developing country spent less than 60 seconds in writing medication and counseling the patient; lack of concentration due to long patient queue or crowded environment; verbal and telephone prescription order have significantly contributed to PEs [9].

ii. The Role of Pharmacist in Dispensing Errors (DEs): This is due to incorrect medicine supplied to patient. Usually, it happened as a result of discrepancy between prescription and medicine supplied by pharmacist; right drug may be supplied but with wrong dosage, dosage regiment, route of administration or supplied to a wrong patient [6]. DEs are of three types including failure to detect and resolve PEs, failure to detect manufacturers' error, and inadequate patient counseling. DEs are considered as failure in quality assurance and pharmaceutical care which are the primary responsibility of pharmacist team [6]. However, when it comes to medicine, pharmacy is the control center, as careful assessment of prescription and accurate dispensing can safeguard patient from all types of MEs [6]. DEs may also include wrong quantity or volume, wrong expiry date, omission or inclusion of unnecessary items. Study reported that the prevalence of DEs as 0 - 45% [6]. The incidence of DEs should consider not only the reported cases but the whole dispensing process [6].

iii. The Role of Nurses in Drug Administration Errors (DAEs): DAEs happens when drug is administered not according to the prescription order; also due to the failure to detect and resolve errors committed during prescription, transcription, dispensing and finally drug administration [7, 19]. Prevalence of DAEs can be determined by measuring its rate of occurrence. Observational method was the best tool employed [7]. Studies have revealed that the prevalence of DAEs ranges from 14.9% to 32.4% [7, 20-21]. Similarly the rate of error committed with intravenous medicine was higher compared to other medications [7]. Furthermore, it was established that DAEs is commonly associated with wrong calculation. Appraisal reported that the rate of error committed with intravenous drugs was 88 in every 100. Similarly, use of wrong frequency occurred in 21.6 in every 100 doses and the rate of omission of dosages was 8.1 to 50 in every 100 doses [7]. In general, the average rate of DAEs quite high therefore, it is essential to detect and correct all forms of MEs [7].

Sources of MEs

i. Sources of PEs: PEs may arise from any of the procedures involved in prescription. Poor diagnoses, wrong medication, wrong dosage, wrong dosage regiment and wrong timing are the major contributors [2, 5]. In addition, prescribing to the wrong patient, prescribing without the patient's consent, off-label use of drug, failure to consider concurrent disease or concurrent treatment causes PEs [2, 22]. Furthermore, lack of accuracy, illegible writing, confusing brands names, incomplete writing and use of complex abbreviation significantly contribute to PEs [5, 22]. Similarly, individual nature of patient is very important including medical history, body size, weight and genetic variation. Research have shown that unintended omission of drug or dosage regiment accounts for 15 – 59% of PEs, wrong or incomplete medical history was found to harm 33.3% of the patient taking at least four drugs, moving patient from one hospital ward to another also contribute to PEs [5]. According to the theory of human error, PEs mainly depend on individual skills but also significantly contributed by failure of the system such as poor working environment, use of complex procedure and large number of patients [5]. The contribution of human factor and individual skills is very important. Lack of feedback among health care professionals plays a vital role in PEs. Therefore, it is necessary for pharmacist and nurses to give feedback to the doctor in case of any doubt regarding information [5]. Mutual understanding among health care professional is necessary, lack of cooperation may generate cascade of event leading to ADRs. Sometimes it may become necessary to evaluate the knowledge, attitude and practice towards PEs of individual prescriber, working condition, and stress level. It is important to note that prescription process does not end at generating prescription; there is also need to monitor the patient [23]. PEs is strongly associated with junior doctors, hence they should be well supervised and their working condition needs to be standardized [23].

ii. Sources of DEs: DEs may be committed by any of the pharmacy staffs but pharmacist is solely responsible for any error that occurred in the pharmacy. It was established that source of DEs can be detected using semi-structured questionnaire; this involved conducting survey to evaluate the attitude and opinion of practicing pharmacist [6]. Survey conducted in UK hospital reported up to 106 different causes of DEs; the most common sources of DEs were categorized as busy schedule (21%), shortage of staffs (12%), interruptions (9.4%), time limitation (11%), sound-alike / look-alike medicine (8.5%), and fatigue (11%) [6]. Another study conducted in Danish reported similar findings [24]. Survey carried out on pharmacist revealed that DEs were due to nature of drugs involved (10%), poor organization (37%), poor prescription (17%), and lack of patient cooperation (4%), as well as in-experienced staffs (30%) [6]. Studies have shown that dispensing wrong strength, failure to confirm doubtful information from prescriber, failure to supply complete dose for the duration of treatment, cutting of medicine from the strips which remove vital information like expiry date causes DEs [2, 22]. Research conducted in USA indicated that majority of DEs were due dispensing drug with possibility of drug interaction. This is usually attributed to telephone prescription order and too much work load in the pharmacy [25]. Lack of standard operating procedure, scanty dispending materials, scarce staffs and poor working environment are the major sources.

iii. Source of DAEs: DAEs are divided in to three including individual health care professional failure, system failure, and problem of underreporting [7]. Standard medication procedure, adequate drug administration tools as well as standard time table for administering drug are necessary for a successful treatment. Nurses are mostly associated with DAEs; although doctors and pharmacist has some contributions. Nurses poor knowledge and concentration; complacency; work load and lack of understanding of errors [7]. Common errors committed by nurses include use of wrong-patient, wrong-dosage, wrong-time, wrong-calculations. Equally, wrong-drug, error in drawing up the medicine, introduction of contaminants, combining incompatible medicines, wrong-dilution, and off-label use of drug significantly contribute to DAEs [2, 7, 22]. System failure includes poor hospital and ward environment, bureaucratic operation system, ineffective means of communication, inadequate staffs and equipment [7]. Presently, more attention is given to system failure rather than individual failure in eradicating sources of DAEs. Underreporting of DAEs often lead to more error; reporting of DAEs will actually triggers to develop ways and means to prevent MEs. Many factors were established to be the cause of underreporting, include fear of punishment, loss of confidence by patient and complexity of reporting procedure [7].

Prevention Strategies
Prevention of MEs targets the individual health care professionals' failure, system failure and incidence of underreporting. Three preventive measures were employed in tackling MEs including strategy to improve medication safety, strategy to reduce MEs as well as MEs reporting and feedback.

i. Strategy to Improve Medication Safety: The first step to avoid MEs is to increase medication safety by providing all the necessary information which includes reference books, journals, and tools like internet in the hospital with cooperative work-setting and satisfactory level of workforces. Committee on Quality of Health Care in America (CQHA) has come up with plans to improve treatment process and ensure safety [26]. The plans made include providing standard prescription guidelines, providing adequate information to the patient, providing software for electronic prescription and drugs should be prescribed with generic names. PEs should be monitored by drug and therapeutic committee [8]. The committee also suggested that all drug and related products should be kept in the pharmacy. High risk medicines should be supplied to the wards only when they are required. Similar drugs and equipment must be separated; patient and nurses should be counseled adequately by pharmacist. Pharmacist should support drug and therapeutic committee to detect MEs and report [27]. Nurses must be provided with standard operating procedure, medication time table, watch and wall clock. Nursing staffs should keep all hazardous medical-product under lock and key. There should be strong cooperation among health care professionals. Nurses must be respected and consulted in terms of treatment progress. Finally each hospital should develop and adopt their own plan to minimise MEs [26].

ii. Strategy to Reduce MEs: Three methods were employed to reduce MEs associated with individual health care professionals and system failure including use of 'Bar coding-Bar code (BPOC), physician computer order entry (CPOE), and pharmacist clinical activities' [8, 28-29]. Bar coding scanner verifies that the prescriber, pharmacist or nurses are dealing with the right-patient, right-drug, in a correct dose, correct-time and correct-route of administration. This instrument is very efficient makes less than one error per million scans [28]. Prescriber usually apply Bar-code and relate a given prescription with a particular patient then forward to the pharmacist. Pharmacist dispenses the unit dose of the medication according to the bar-code and finally forwards to the nurse. Subsequently, nurse use the bar-code scanner and confirm the right-patient for medications [8]. CPOE involves the use of computer by prescriber to send prescription to the pharmacy using specific patient information. This system was established to reduce PEs by 83% [28, 30]. Another study indicated that CPOE has significantly reduced the incidence of ADRs due to MEs by 55% [8]. Physician usually diagnoses the patient, entered the summary of

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diagnoses into the computer and recommends appropriate medications for the patient, the computer analyses the possibility of allergy, incompatibility and drug interaction based on the documented patient diagnosis and medical history. The final prescription produced usually contained the right drug at a right dose and dosage form for the intended patient [8, 28]. Pharmacist clinical activity is of paramount significance for quality assurance and ideal patient care; also their involvement in team of health care professionals will promote better patient care; and uphold rational use of medicine, detection and instant reporting of ADRs and MEs [8]. It is testified that presence of pharmacist during ward round by the medical-consultant reduces MEs up to 66% [8].

iii. MEs Reporting and Feedback: Reporting MEs is very significant in assessing the type and nature of error committed as well as devising appropriate preventive measures. The reporting procedure should be made simple to encourage reporting. Health care professionals should be counselled about MEs reporting which is their certified obligation. Reporting MEs should be confidential. There may be need to conceal the identity of the reporter. Reporting should be done immediately after detection, thus experts can intervene and prevent ADRs [5]. The next stage is to disseminate the information among the health care professional to get-out from future miseries [5]. Studies have shown that MEs can be identified, assessed, and reported using active interventional method which involves chart review and patient monitoring. This method was established to be 10 times more effective in tackling MEs and ADRs than spontaneous reporting [5]. The complete process of active intervention include proactive detection of MEs, reporting and feedback control system, improving all health care professionals' knowledge, as well as simplifying all complex procedures involved in prescription, dispensing and drug administration [31].

CONCLUSION

Health care professional at all level have an important role to play in reducing the menace of MEs. Several efforts have been made to reduce the incidence of MEs, but these attempts suffered a serious setback due to the problem of under-reporting. The sources of MEs identified were multi-factorials and multi-disciplinary which justified that nobody is above the mistake. There is also need to evaluate knowledge, attitude and practice of medical doctors towards MEs prior to initiation of patient treatment. Pharmacist role in clinical activities play a great role in reducing MEs. All health care providers need to embrace approach of Evidence Based Medicine (EBM) which is the most conscientious, explicit and judicious use of current best evidence in making decision about the care of individual patient. Use of information and communication technology (ICT) has eloquently revolutionized the health care delivery services. There is urgent need to employ the use of ICT in every hospital by all developing countries in order to make a remarkable progress in addressing health and medication related problems.

Limitation of the Study: The article covers only three main types of MEs out of six. It only covers the sources of MEs gathered within limited time frame; more articles are available which will contribute to the knowledge that was not accessible to the authors.

Conflict of Interest
This study obtained no funding and authors possess no conflict of interest.

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