

THE CHARACTERIZATION OF PRESCRIBING  
ERRORS AND ASSESSMENT OF THE IMPACT OF  
AN EDUCATIONAL INTERVENTIONS AMONG  
MEDICAL OFFICERS WORKING IN  
KUALA KANGSAR HOSPITAL

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## **DEDICATION**

I would like to dedicate this dissertation to my family and friends, without whose support,  
love and care, I would not have realized my dream in life

To the loving memory of all those who have passion in the scholarship of teaching,  
learning, research and helping humanity.

## **QUOTE**

“ A thousand miles journey begins with a step”

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## **LIST OF ABBREVIATIONS**

<b>Abbreviations</b>	<b>Intended meaning</b>
NCCMERP	National Coordinating Council for Medication Error Reporting and Prevention
IOM	Institute of medicine
CPOE	Computerized physician order entry
UK	United Kingdom
USA	The United States of America
BNF	British National Formulary, volume 54
JNC 7	The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure
MIMS	Malaysia index of Medical Specialties, Volume 112
ATP III	Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (ATP III Final Report)
MOH	Ministry of Health Malaysia
CPE	Continuing professional education talks

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**PENGLASIFIKASI RALAT PENULISAN PRESKRIPSI DAN PENILAIAN  
IMPAK INTERVENSI PENDIDIKAN DI KALANGAN PEGAWAI PERUBATAN  
YANG BEKERJA DI HOSPITAL KUALA KANGSAR**

**ABSTRAK**

Peningkatan kadar ralat penulisan preskripsi di institut kesihatan telah menjadikan ralat penulisan preskripsi sebagai satu isu yang sangat penting dalam sistem penjagaan kesihatan di Malaysia. Pegawai Farmasi memainkan peranan yang penting untuk memperbaiki dan menghalang pesakit daripada mengalami kesan ralat penulisan preskripsi. Pengenalpastian ralat penulisan preskripsi adalah penting untuk menjamin intervensi yang dijalankan berjaya mengurangkan ralat tersebut. Kepentingan isu ralat penulisan preskripsi boleh diuji melalui analisis keterukan ralat tersebut. Objektif kajian adalah untuk menentukan lima jenis ciri ralat penulisan preskripsi yang paling biasa, menilai keterukan insiden ralat penulisan preskripsi dengan menggunakan index penilaian kesilapan medikal NCCMERP, menentukan peratusan ralat penulisan preskripsi yang dicegah oleh ahli farmasi dan berbanding kadar ralat penulisan preskripsi sebelum dan selepas intervensi pendidikan. Kajian retrospektif telah dijalankan dari 1 April sehingga 30 Mei 2008 di hospital kerajaan tahap sekunder untuk meninjau preskripsi yang ditulis oleh doktor dan preskripsi yang memenuhi kriteria telah dianalisis untuk mengenalpasti jenis ralat penulisan preskripsi. Pada masa yang sama, penilaian keterukan setiap ralat telah dilakukan untuk mengenalpasti keterukan ralat penulisan preskripsi di hospital. Selain itu, kajian retrospektif preskripsi telah memberi maklumat sejauh mana keupayaan ahli farmasi memainkan peranan mencegah ralat sebelum diterima oleh pesakit. Kajian

prospektif telah dijalankan selepas tempoh 4 bulan intervensi pendidikan untuk menguji keberkesanan tindakan penambahbaikan. Sembilan puluh empat peratus ralat penulisan preskripsi adalah berpotensi klinikal. Lima ralat penulisan preskripsi yang tertinggi adalah: (1) interaksi drug-drug (67.6%); (2) dos yang tidak sesuai (13.7%); (3) kontraindikasi (8.3%); (4) ralat yang dikaitkan dengan meninggalkan maklumat (4.7%) dan (5) drug yang dipreskripsi tanpa indikasi (1.3%). Kurang daripada satu per lima (16.7%) insiden ralat penulisan preskripsi boleh mendatangkan mudarat kepada pesakit. Hanya 3.16% ralat penulisan preskripsi telah dikesan dan dicegah oleh ahli farmasi sebelum pesakit menerima drug mereka. Intervensi pendidikan yang diberikan memberikan hasil akhir positif yang signifikan untuk memperbaiki ralat penulisan preskripsi. Intervensi tersebut berjaya meningkatkan preskripsi tanpa ralat sebanyak 3.5% dan mengurangkan 9.8% daripada jumlah keseluruhan ralat tetapi pengurangan ini tidak mencapai sasaran 10%. Secara keseluruhan, tindakan intervensi pendidikan memberikan hasil yang positif dalam mengurangkan ralat penulisan preskripsi. Penerusan dan kesinambungan aktiviti intervensi adalah penting kerana intervensi pendidikan sangat bergantung kepada respons daripada doktor dan pengaruh kumulatif tindakan intervensi.

**THE CHARACTERIZATION OF PRESCRIBING ERRORS AND ASSESSMENT  
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**ABSTRACT**

The increasing trend of prescribing error in the healthcare institutes cause it became an issue of concern in Malaysia's healthcare system. Pharmacist plays an important role to improve and prevent patients receiving these errors. Identification of prescribing errors is important to ensure the interventions successfully improve the prescribing errors. The seriousness of prescribing errors can be evaluated by assessing the errors' severity. The objectives of the present study were to identify the five most common types of prescribing error characteristics, evaluate the severity of the prescribing errors incidence, determined the percentage of prescribing errors prevented by pharmacists and evaluate the effectiveness of the education intervention. A retrospective study reviewing newly written prescriptions with fulfilled criteria which wrote between 1<sup>st</sup> April and 30<sup>th</sup> May 2008 was conducted in a secondary care setting government hospital to analyse the type of prescribing errors. At the same time, the evaluation of severity of each error was done to identify the seriousness of prescribing errors in the hospital. Besides, the retrospective review of prescriptions provided the data on how far the pharmacists practicing their role in preventing prescribing errors. A prospective study on the prescriptions was conducted after 4 month period of educational interventions to evaluate the effectiveness of the improvement plan. Ninety four percent of prescribing errors were clinical potential prescribing errors. The top five prescribing errors were: (1) drug-drug interaction (67.6%);

(2) inappropriate dosage (13.7%); (3) contraindication (8.3%); (4) omission errors (4.7%); and (5) medications prescribed without indication (1.3%). 80.49% and 3.17% of prescribing errors were categorized as severity Level A and B approximately. 16% of the prescribing errors were categorized as Level D and only one prescribing error was categorized as Level E. No errors were categorized at a level more severe than Level E. Only 3.16% of prescribing errors were detected and prevented by pharmacists before patients receiving their medications. The education intervention provided a significant positive outcome to improve the prescribing errors. The intervention successfully increased 3.5% of free-error prescriptions and reduced 9.8% of total baseline prescribing errors but the reduction did not achieved the target of 10%. In conclusion, education intervention managed to reduce prescribing errors and improved patient safety in the healthcare institutes. Therefore, ongoing activities to improve prescribing error is important because the successful of the educational intervention highly depend on the responsiveness of prescribers and the cumulative effect of the interventions.



# CHAPTER 1

## GENERAL INTRODUCTION

### 1.1 Introduction

In Malaysia, healthcare institutes are divided into two sectors- the public sector and the private sector. The public sectors are those hospitals or health clinics subsidized by the Ministry of Health. The vision of The Ministry of Health is providing a better health to public by nation working together among all healthcare professionals. Patient injuries occurring in the hospitals will fail to achieve the vision, at the same time, these will fail to achieve the patient's desired outcome and increase the hospital's costs (Øvretveit, 2003). In conclusion, ensuring quality will therefore avoid wasting resources that could be used to treat more patients (Øvretveit, 2003).

The quality of healthcare and patient safety is influenced by the quality service provided by the professionals in the healthcare organisations. Insufficient knowledge and experience may reduce the quality of healthcare. Doctors working independently after completing their housemanships lack experience and guidance, at most of the peripheral hospitals and health clinics, resulting in reduced levels of patient safety. Most of the experts work in the state general hospitals and specialized institutes and visit the clinics once a month or weekly like Sungai Siput Hospital and Kuala Kangsar Hospital, which is insufficient to provide proper guidance to these medical officers. Experienced pharmacists work in the general hospitals, while young and less experienced pharmacists work in these peripheral clinics and may not be able to provide comprehensive pharmaceutical care to patients. They may lack of experience and fail to influence their interaction with the doctors. In conclusion, the healthcare professionals working in

these institutes may be unable to provide high quality service to their patients due to their insufficient experience.

The level of patient safety in the healthcare institution is an important issue in Malaysia. One patient safety issue which is always discussed is medical error. The roots of these medical errors need to be identified because it is believed that reducing them may require the introduction of different approaches. These errors harm not only the patients but also the doctors, as hospitals always find out and blame the doctors for mistakes. From the report *To Err Is Human: Building a Safer Health System*, healthcare is anything but failsafe as 44,000-98,000 people die in hospital a year in the United States due to medical errors (Kohn, Corrigan & Donaldson, 1999). In Malaysia, a study has reported that 50% of medical records reviewed contained at least one medical error (Khoo et al., 2008). This shows how urgent and important this issue is.

Medical errors can be defined as the failure of a planned action to be completed as intended, or the use of a wrong plan to achieve an aim (Kohn et al., 1999). From this definition, medical errors are any errors that occur within the healthcare system (Ghaleb et al., 2006) and include improper transfusions, surgical injuries, mistaken patient identities and wrong site surgery (Kohn et al., 1999). They occur in a variety of forms, from prescribing suboptimal pharmacotherapy to administering drugs wrongly (Guchelaar & Kalmeijer, 2003). One of the medical errors is medication error, which is defined as any discrepancy between the prescriber's order and what is actually administered to the patient (Flynn, Barker, Pepper, Bates, & Mikeal, 2002).

Medication errors cover all errors which relate to medications. These errors can be targeted for reduction because different approaches have been discussed in previous studies (Bates, 2000; Grasso, Bates, Shore, Saenger & Hart, 2003; Huertas Fernández,

Baena-Cañada, Martínez Bautista, Arriola Arellano, & García Palacios, 2006; Shaw et al., 2003; Vasileff, Whitten, Pink, Goldsworthy, & Angley, 2009). Furthermore, their incident rate has been increased yearly in many countries: for example, a report by the Poison Information Center (PIC) in Finland showing that medication errors in healthcare are on the rise (Kuitunen, Kuisma & Hoppu, 2008). In addition, Kohn et al. (1999) reported that 1 in 131 outpatients and 1 in 854 inpatients were dying due to medication errors in the United States, while (Lustig, 2000) showed that the overall medication error rate for the Barzilai Medical Center, Israel was 11.2 per 1000 prescriptions. The reporting of medication errors in Malaysia is voluntary-based. However, It was found that a total of 2,572 medication errors were received by the Malaysian Medication Error Reporting System which started 2009 (The Star, 2010).

Besides, a study which carried at Ipoh Hospital, Malaysia at 2006 was found that the medication error rates was around 14.2% and 16.7% at ward 7A and ward 7B approximately (George D., Ku Abd Rahim K. N. & Mohd Azmir N, 2006). Out of 50% of these medication errors were prescribing errors occurred in medical ward (George D., 2006). The type of errors happened were including incomplete prescription, order unwritten in medication chart, order unwritten in bed head ticket (BHT), different order written in BHT and medication chart, expired prescription, polypharmacy prescribed and other prescribing errors (George D., 2006). In conclusion, the high rate of medication errors need the involvement of pharmacists clinically in the wards to help reducing the occurrence of prescribing errors because they will ensure the prescriptions were complete and correct before sending to pharmacy and they will carry out the intervention once error detected by discuss with the doctors.

Medication errors also increase healthcare expenditure. The estimated costs of these errors were \$17 billion - \$29 billion per year in the United States (Kohn et al., 1999). What is more, these errors may prolong the sickness or hospitalization time and reduce the patient's quality of life by potentially causing them physical or psychological discomfort. Medication errors are clearly becoming a big issue for healthcare systems and preventing them requires inter-professional teamwork (Pi é & Warholak, 2008).

Prescribing errors, one of the common medication errors should be targeted in order to improve the quality of care and patient safety, the more so since prescribing error rates are increasing in many countries. For example, four primary care practices in Boston were found to have a prescribing error rate of 7.6 per 100 outpatient prescriptions (Gandhi et al., 2005), while a study by Devine et al., (2007) showed that almost 28% of the prescriptions they evaluated contained one or more errors or potential errors. In another study, conducted in the Internal Medicine Department, San Francisco Xavier Hospital, 59 cases of prescribing errors were detected out of 73 cases of medication errors ( Mirco, Campos, Falc ão, Nunes, & Aleixo, 2005). In conclusion, attention needs to be paid to prescribing errors, not only because they are one of the main medication errors, but because some of them may bring about irreversible complications for patients with chronic illnesses, especially geriatric patients.

## **1.2 Problem Statement**

Prescribing error is one of an important patient safety issue in the healthcare system. Pharmacists had to intervene in 111,830 out of 993,779 prescriptions between January and June 2008 due to prescribing errors ( Bahagian Perkhidmatan Farmasi Perak, 2008). This means that 11.25% of prescriptions contain at least one prescribing error in

Perak state. Besides, the prescribing error rate was 1.39% at Hospital Putrajaya ( Ponto, Ismail, Abdullah, Abdul Rafar & Aziz, 2009). Moreover, the prescribing error intervention rate reported by each hospital should not be more than 2.5%. This might encourage the reporter not to report the real figure. It is strongly believed that the prescribing errors reported represent only the tip of the iceberg because most of them were errors which could not have been concealed and were easily identifiable (Flynn et al., 2002).

Patient's quality of life may be reduced due to the consequences of prescribing errors. Gandhi et al. (2005) found that 3% of total prescriptions contained prescribing errors which had potential of patient injury. The injury may prolong the hospitalization time or reduce the patient's quality of life causing them physical and psychological discomfort. Besides, it also wastes the healthcare institute's source and increase the expenditure.

High rate of prescribing errors shown pharmacists still have to take more aggressive effort in their clinical activities. In Bosma et al. (2008), healthcare institute with more pharmacists involved in clinical pharmacy relatively increased medication safety because they may contribute to the rationalization of drug therapy. Therefore, pharmacists should be encouraged actively involved in the clinical activities like patient's medication history assessment, routine rounds in ward and others to ensure the quality of service providing in the institute.

The breakdown of interdisciplinary communication may contribute to a high rate of error. It is believed that well interdisciplinary communication and cooperation in identifying and resolving prescribing errors can achieve optimal therapeutic outcomes for patients. For example, less of communication and cooperation between pharmacists

and prescribers may contribute to inadequate drug information for prescribers to assess and this surely prone to contribute prescribing errors.

### **1.3 Rationale and the importance of study**

A proper strategy may reduce prescribing errors, hence these are the errors that this study targets. The literature has clearly stated that they can be reduced using several methods, including computerized physician order entry (CPOE) systems (Koppel et al., 2005), feedback reporting (Franklin et al., 2007) and pharmacist intervention (Flynn et al., 2002). Identifying the types of errors is very important to ensure that the correct interventions can be introduced. Moreover, evaluation of severity of each error may provide a better understanding of how prescribing errors bringing harm to patients.

Patients will only benefit if they receive proper error-free treatment. Any mistakes during treatment, including prescribing errors, may be damaging. For example, improper prescribing of dosage may result in either the patient not reaching the therapeutic range of the medication, or in experiencing its toxic effects. The toxicity of the medication may cause other complications, such as liver or renal impairment, while a dosage under the therapeutic range may not help the patient and may instead complicate the patient's disease. Therefore, the prescribing error may not only reduce the patient's quality of life but may also waste hospital expenditure by prolonging hospitalization and treatment.

Most of the studies in Malaysia have only focused on the reporting of prescribing errors, but none have looked at the effectiveness of interventions or improving strategies to reduce these errors. If the interventions are successful in lowering the error rate then it is suggested for other hospitals to introduce them to decrease their prescribing errors.

## **1.4 Hypothesis**

It is believed that the prescribing error rate will reduce after implementation of the multiple education interventions.

## **1.5 Objectives**

This study was conducted based on the following objectives:

1. To identify the five common types of prescribing error characteristics.
2. To determine the severity of prescribing error incidence.
3. To determine the percentage of prescribing errors prevented by pharmacists.
4. To compare the prescribing error incidence rate before and after the implementation of education interventions.

## **1.6 Scope of the study**

This study will focus on the prescribing errors which can be determined through prescriptions. Some prescribing errors may be considered potential errors because they are difficult to confirm, especially those drug related problems which require monitoring of the patient's condition. This study looked at prescribing errors for common chronic diseases, restricting its focus to cardiovascular diseases, diabetes mellitus and psychoses and related disorder which poor controlled of these disease may lead to undesire complications and reduce the patient's quality of life.

## **1.7 Contributions of study findings**

It is important to identify the characteristics of prescribing errors in order to find the root of the problem. From here, proper interventions or improving strategies can be

implemented to improve patient safety in the healthcare institute. Patient safety should be attended to by the healthcare organisation because ignoring it not only harms the patient but also wastes the resources of the organisation. For example, if a patient has been given an incorrect prescription, that error might poison him (patient injury), causing him to need more of the hospital's resources to treat the problem. In short, identifying the characteristics of prescribing errors can help improve patient safety and provide a positive outcome for the patient.

The participation of pharmacists can help lower these incidents. By providing feedback to doctors about prescribing error rates, pharmacists can help reduce the errors. Pharmacists should be encouraged to be actively involved in improving error rates and should therefore not be excluded from any improving strategies implemented.

This study aims to make prescribers and hospital management aware of how serious prescribing errors are. The severity of these errors gives an indication of the harm prescribers can do to their patients. This may lead prescribers to be more cautious when they are prescribing medicines. Prescribers welcomed pharmacists improving the error rate, and this study may lead to a cooperative relationship as they work together to reduce prescribing errors.

Overall, this study may provide different benefits to both patients and healthcare professionals particularly at Kuala Kangsar Hospital.



## CHAPTER 2

### LITERATURE REVIEW

Different healthcare institutes, even in the same field, were found to make significantly different types of prescribing errors at significantly different rates (Shah, Aslam, & Avery, 2001). Similarly, different departments within the same healthcare institute may also make different prescribing errors at different rates: For example, outpatient departments had higher prescribing error rates than wards, possibly because outpatient providers work under more intense time pressures, and they may be less familiar with the correct prescribing parameters because more classes and brands of drugs are available in this setting (Gandhi et al., 2005). The review articles in which prescribing errors are discussed have therefore looked at them from different angles, including their definition, characterization and the improvement strategies aimed at their reduction. In addition, it was found that some studies focused on seriousness of the prescribing errors, the impact of prescribing errors on specific populations, such as geriatrics, evaluating the severity of prescribing and other errors.

Understanding the definition of prescribing errors before conducting a study on them is important. This is because the definition helps to identify their characteristics. Dean, Barber, & Schachter (2000) therefore developed the following definition, using a two-stage Delphi technique to distinguish which situations should be included as prescribing errors:

“A clinically meaningful prescribing error 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 when compared with generally accepted practice”.

This definition has been widely used, and was adopted and employed in the present study to identify prescribing errors.

Generally, prescribing errors can be divided into four main groups. These are: errors of omission, errors of commission, errors of integration or knowledge-based errors, and skill-based errors (Al Khaja, Al Ansari, Damanhori & Sequeira, 2006; Bobb et al., 2004). According to Al Khaja et al. (2006), omission errors include the absence of prescription components such as date of prescription, physician’s signature and stamp, and patient’s personal identifiers. Meanwhile, the incorrectly written components of the prescription are considered errors of commission. The commission errors is incorrect prescription information which including mistakes in writing drug names, choosing the wrong strength of the drug, mistake in the required number of dosage units, mistake in prescribing similar drugs and others (Mortazavi & Hajebi, 2003). The errors of integration or knowledge-based errors include potential drug-drug interactions which may require the pharmacist’s intervention, prescribing inappropriate to the specific population, or drug allergies. Skill-based prescribing errors include illegible handwriting and use of inappropriate abbreviations.

However, not all studies have included all of these groupings. A 2006 study conducted in Bahrain excluded skill-based prescribing errors from its criteria for prescribing errors (Al Khaja et al., 2006). Another study, conducted in Chicago, United States in 2002, also excluded skill-based prescribing errors (Bobb et al., 2004). However, skill-based prescribing errors were included in another study, conducted in Spain in 2005, which evaluated the impact of computerized chemotherapy prescriptions

on the prevention of medication errors (Huertas Fernández et al., 2006). Meyer et al. (2000) also included skill-based prescribing errors in a study designed to improve the quality of prescription writing, but the study excluded integration or knowledge-based prescribing errors. Nonetheless, studies were found that did include all these categories, including a study conducted in the United States in 2002 (Devine et al., 2007; Jani et al., 2008). In conclusion, even though the definitions of prescribing errors used in these studies were similar, the criteria used to determine which types of prescribing errors to include differed depending on the decision of the researchers.

Besides describing epidemiology, it was found few studies discussing the seriousness of prescribing errors in the healthcare system in Malaysia. For example, a study which conducted in Raja Permaisuri Bainun Hospital was found that nearly half of medication errors identified were prescribing errors especially in the medical wards (George, Rahim & Mohd Azmir, 2008). Another report from Khoo et al. (2008) also found that prescribing errors were one of the contributor of medical errors in the primary care clinics in Malaysia. Besides, a prevalence of error in prescriptions was conduct at Hospital Universiti Sains Malaysia was found that thirty two percent of all the prescriptions reviewed contained at least one error (Ahmad F., Bahari Ismail S. & Mohd Yusof H., 2006).

In addition, it also can be found a lot of studies discussing the seriousness of prescribing errors at oversea. An Isreal study was found that 60.6% of medication errors were prescribing errors which the most common prescribing error was inappropriate dosage prescribed by prescribers (Lustig, 2000). In United States, a report of assessing the status of hospital patient safety systems was published and found that the current hospital patient safety system was not close to the Institute of Medicine (IOM)'s

recommendation (Longo, Hewett, Ge & Schubert, 2005). From here, it was clearly shown that prescribing errors was one of the hospital's patient safety system issue.

Moreover, many studies had tried different approaches, either electronic or non-electronic, to reduce prescribing errors. Computerized prescribing helps reduce the rate of prescribing errors, especially those resulting from the insufficient knowledge of the prescribers (Gandhi et al., 2005; Bates, 2000). Computerized prescribing is able to provide prescribers with drug information, such as drug dose checking and drug frequency checking, and alert them during the prescription writing process (Gandhi et al., 2005; Lapane, Waring, Schneider, Dubé & Quilliam, 2008). A study in Chicago, United States described the effectiveness of a CPOE system and found that most of the prescribing errors (approximately 75%) prevented by it which the system were associated with clinical decision support (Bobb et al., 2004). Jani et al. (2008) also found the computerized system increased the percentage of error free visits to the pediatric renal outpatient clinic at an acute tertiary care hospital in the United Kingdom from 21% to 90%. In conclusion, computerized prescribing systems with advanced clinical decision support could reduce the number of prescribing errors and improve medication safety in hospitals.

However, there are still some studies which take the opposite view of computerized prescribing. Shah et al. (2001) found no significant difference in the prescribing error rates between handwritten and computer-generated prescriptions. Koppel et al. (2005) found that one CPOE system facilitated up to 22 types of medication error risk, including information errors. For example, prescribers misleading by the pharmacy inventory displays because they mistaken it as dosage guidelines while they were prescribing medications to patients (Koppel et al., 2005). In addition,

computerized prescribing does not correspond to work organization and prescribers were prone to select the wrong patient file because names and drugs were close together (Koppel et al., 2005). Users may also select the wrong medication because up to 20 screens might be needed to view a patient's medications. Lapane et al. (2008) found that the drug alert system in CPOE was too sensitive and unnecessary. This may be caused by the prescriber ignore the alert and missing some important information like patient's clinical laboratory result or potential drug-drug interaction. As such, clinicians and hospitals should attend to CPOE-facilitated errors, as well as to the errors which they prevent.

In addition to discussing the pros and cons of computerized prescribing, some studies suggested that non-electronic intervention measures, such as interactive educational meetings, feedback and academic detailing, should be introduced to reduce prescribing errors (Elnour, Ellahham & Al Qassas, 2007; Franklin et al., 2007; Meyer, 2000; Shaw et al., 2003). These interventions were focused on changing the prescribers' behavior and increasing their awareness. The objective of the education program was to improve the staffs' knowledge and raising their awareness about the issue. Elnour et al. (2007) was successful in raising the awareness about medication errors among the nursing staffs in Al Ain Hospital, Dhabi through implementation an education program. The involvement of pharmacist helps to prevent and reduce medication errors (Vasileff et al., 2009).

Moreover, these interventions were always combined for implementation to ensure the successful of the plan. A study in Copenhagen, Denmark found that combined intervention (interactive educational meetings and feedback) could improve medication error rates significantly in comparison to a control group and single

intervention, even though the method required more time and money (Bregnhøj, Thirstrup, Kristensen, Bjerrum & Sonne, 2009). A study conducted in Australia revealed that prescribing errors were reduced by academic detailing because the detailing provided a chance for the doctors to understand the problems they encountered when writing prescriptions (Shaw et al., 2003). A study conducted by Meyer in 2000 also tried to reduce prescribing errors by combined interventions, such as giving each physician a self-inking stamp, presenting the results to councils like the Pharmacy and Therapeutic Council, and introducing an educational program for all physicians (Meyer, 2000). From the literature review it appears that, with ongoing effort, combined interventions may help to reduce prescribing errors more significantly than single interventions.

It was found that few reviews had been published apart from those describing epidemiology and interventions to reduce prescribing errors. One review from America discussed the existing evidence on interventions aimed at reducing medical errors in the healthcare system (Loannidis & Lau, 2001). The interventions discussed in the review for improving errors were included: the participation of the pharmacist in rounds, team intervention, automated bedside dispensing, the provision of leaflets and others (Loannidis & Lau, 2001).

Besides, the medication errors in specific population like elderly or pediatric patients were discussed. For example, Ghaleb and colleagues (2006) reviewed the previous studies which related to medication errors in children. From the review, they found out the most common medication error was inappropriate dosing which was a type of prescribing errors and the medications involved were those frequently used like antibiotics and sedative agents.

Elderly patients were always suffered the adverse consequences when medications were prescribed unnecessarily (Aspinall, Sevick, Donohue, Maher, & Hanlon, 2007; McLeod, Huang, Tamblyn & Gayton, 1997). The types of inappropriate prescribing were including excessive doses or durations of a medication, inadequate monitoring and indication for use or prescribing was suboptimal (Aspinall et al., 2007). From this, inappropriate prescribing to elderly patients should include because prescribing errors may reduce the effectiveness of treatment and increase the harm caused to these patients.

Therefore, Beers Criteria (Fick et al., 2003) in America and the McLeod List (McLeod et al., 1997) in Canada are established guidelines for prescribing to the geriatric population. Beers criteria, a list of inappropriate prescribing in the elderly in nursing home were developed in 1991. The criteria were update in 2002 (Fick et al., 2003). Another hand, McLeod and friends (Fick et al., 2003) disagreed with the Beers Criteria and developed a list for inappropriate prescribing in elderly patient in Canada in 1997 because they disagreed the designation of Beer criteria and some of the drugs listed in Beers Criteria such as isoxsuprine, cyclandelate and propoxyphene have fallen into disuse (Fick et al., 2003). However, there are many issues and challenges in Malaysia that face geriatric services including the recruitment, development and retention of key medical and paramedical staffs (Philip J.H.P, Forsyth D.R, Daniel K.Y.C, 2004). Lack of geriatricians and most of the new trained geriatricians opt to enter a variety of private practice setting may cause lack of training in gerontology in medical school (Philip J.H.P, Forsyth D.R, Daniel K.Y.C, 2004). Therefore, inappropriate prescribing medication was common among elderly patients in Malaysia. For example, it is not prohibit of prescribing tricyclic antidepressants with active metabolic or long acting

benzodiazepines in geriatrics for depression ( McLeod et al., 1997) or using nifedipine immediate released for geriatric patients in treating hypertension ( Fick et al., 2003).

The severity of prescribing errors has been looked at in some studies and they have come to similar conclusions, which is that most of these errors do not cause harm to patients. Devine et al. (2007), looking at prescriptions issued by 60 clinics in 13 geographic locations in Washington in 2004, found that over 30% of the prescriptions contained errors which were categorized in the least severe category (Level A). The study “The Epidemiology of Prescribing Errors” concluded that more than half the prescribing errors (69.2%) were unlikely to have caused harm, while only 11.5% of prescribing errors actually reached the patient and were likely to have caused harm (Bobb et al., 2004). Another study showed that half the prescribing errors found had the potential to cause harm, while the other half did not cause harm to patients (Gandhi et al., 2005). The severity of the prescribing errors was influenced by lack of resources, insufficient patient monitoring, and the study site (Gandhi et al., 2005).

In conclusion, researchers have evaluated different aspects of prescribing errors. Table 2.1 was summarized the literature review discussing in this chapter. From the table, the focus of study, study design, regional focus of study and the finding were discussed. Here, It was found that the prescribing error rate depended on the study design and location, while the definition of prescribing errors also influenced the rate of error. From the literature review, it could be seen that new approaches to identify and reduce potential prescribing errors in the healthcare institutes are needed because these errors have different characteristics in every healthcare institute, requiring different approaches to be taken in each case.



Table 2.1 Summary of literature review using in Chapter 2

No	Study title	Focus	Study design	Regional focus	Finding
<b>Identified the definition of prescribing error</b>					
1	What is prescribing error (Dean et al., 2000)	To define the prescribing errors	Two stage Delphi method	United Kingdom (UK)	Prescribing error is any error which occurring during prescription writing process and it was resulting an unintentional effect which reducing patient's quality of life and outcome.
<b>Prevalence / epidemiology / severity of prescribing error</b>					
2	Medication error prevalence in medical wards- 7A &7B Hospital Ipoh (George et al., 2008)	Type of medication errors	Retrospective screening the prescriptions	Malaysia	44.8% and 54.6% of identified medication errors were prescribing errors in the Ward 7A and ward 7B respectively.
3	Characterization of prescribing errors in an internal medicine clinic ( Devine et al., 2007)	To assess the characteristic of prescribing error	Retrospective review of prescription	The United States of America (USA)	Most of the prescribing errors did not cause harm to patient or reached patient. The error rate can be reduced after implemented of computerized prescribing with clinical decision support system.
4	The long road to patient safety: a status report on patient safety systems (Longo et al., 2005)	To assess the status of hospital patient safety systems	Survey	USA	The current status of hospital patient safety systems still not meet the IOM's recommendations.

Table 2.1 *continued*

No	Study title	Focus	Study design	Regional focus	Finding
Prevalence / epidemiology / severity of prescribing error					
5	Evaluation of drug utilization and prescribing errors in infants: a primary care prescription based study ( Al Khaja et al., 2006)	Prevalence of prescribing errors	Retrospective observation	Arabian gulf	Errors of omission and commission were the most common errors which were occupied 97.6% of errors.
6	The epidemiology of prescribing errors (Bobb et al., 2004)	Epidemiology of the errors	Observation study	Chicago, USA	6.2% of medication orders contains prescribing error and out of 69.2% of prescribing errors were unlikely to cause harm.
7	Prescription errors in Hospital Universiti Sains Malaysia, Kelantan, Malaysia (Ahmad F., Bahari Ismail S. & Mohd Yusof H. ,2006)	Prevalence of prescribing errors	Interventional study	Malaysia	A reduction of errors after intervention program.
The review related to prescribing errors					
8	Evidence on interventions to reduce medical errors: an overview and recommendations for future research (Loannidis & Lau, 2001)	Identify on interventions which successful reduce errors	Randomized review article	-	A review on the effective of interventions done previously by researchers. Most of the error rate will be reduced after interventions.
9	Medication error in older adults: a review of recent publications ( Aspinall et al., 2007)	To examined medication errors in elderly population	Review articles published in 2006 in medline and International pharmaceutical abstracts	-	Medication errors among the geriatric population was examined in this review. The review discussed the possible causes of medication errors.

Table 2.1 *continued*

No	Study title	Focus	Study design	Regional focus	Finding
The review related to prescribing errors					
10	Using information technology to reduce rates of medication errors in hospital (Bates, 2000)	How information technologies reduce error	Literature review	-	CPOE can help reduce medication error rate significant. Robot filling, bar coding, automated dispensing device, automated medication and others help increasing patients' safety.
The review related to prescribing errors					
11	Systematic review of medication errors in pediatric patients (Ghaleb et al., 2006)	Review the incidence of medication errors and identify them in pediatric patients	Review	-	The article concludes that the prescribing errors are a problem but actual problem size was unable to evaluate.
The strategies of reducing prescribing errors ( electronic prescribing)					
12	Role of computerized physician order entry systems in facilitating medication errors (Koppel et al., 2005)	To quantify the role of CPOE in facilitating prescribing errors	Survey and observation	USA	CPOE also will increase probability of prescribing errors in some situations.
13	A mixed method study of the merits of E-prescribing drug alerts in primary care (Lapane et al., 2008)	Physician's perspectives on e-prescribing drug alerts	Mixed method study	USA	The drug alerts system is beneficial to prescribers but their opinion is it too sensitive.
14	Outpatient prescribing errors and the impact of computerized prescribing (Gandhi et al., 2005)	To assess the impact of computerized prescribing.	Prospective cohort study	USA	The computerized system without supportive system may not help to reduce errors.

Table 2.1 *continued*

No	Study title	Focus	Study design	Regional focus	Finding
The strategies of reducing prescribing errors ( electronic prescribing)					
15	Impact of computerized chemotherapy prescriptions on the prevention of medication errors (Huertas Fernández et al., 2006)	Evaluate the impact of computerized prescribing	Observation	Spain	The prescribing errors were decreased after computerized prescribing implementation.
16	A survey of prescribing errors in general practice ( Shah et al., 2001)	To classify errors on prescription and measure the frequent of errors	Retrospective analysis	UK	Handwriting prescriptions associated high proportion of errors. Less of prescribing errors which can harm patient. Besides, different error rates in different surgeries.
17	Electronic prescribing reduced prescribing errors in a pediatric renal outpatient clinic ( Jani et al., 2008)	To assess the effect of electronic prescribing	Pre-post study	UK	Handwritten prescriptions provided higher prescribing error rate compare to the electronic prescribing.
The strategies of reducing prescribing errors ( education interventions)					
18	Raising the awareness of inpatient nursing staff about medication errors (Elnour et al., 2007)	Implemented an education program to in patient nursing staff about medication errors	Pre/post intervention	Dhabi	Education program can improve nursing staff's knowledge and success to raising awareness about medication errors and self – reporting error.
19	Improving the quality of the order writing process for inpatient orders and outpatient prescription (Meyer, 2000)	To improve the prescribing errors	Pre- post study	USA	Education program and providing feedback were a good way to improve prescribing error in inpatient and outpatient.

Table 2.1 *continued*

No	Study title	Focus	Study design	Regional focus	Finding
The strategies of reducing prescribing errors ( education interventions)					
20	Error reduction: academic detailing as a method to reduce incorrect prescriptions (Shaw et al., 2003)	Evaluate the effective of academic detailing as a method to reduce the prescribing errors	Pre-post study	Australia	Academic detailing was an effective way to influence the clinical decision making, while prescribers wrote prescriptions.
21	Combined intervention programme reduces inappropriate prescribing in elderly patients exposed to polypharmacy in primary care (Bregnhøj et al., 2007)	To evaluate the most effective way to reduce the inappropriate prescribing among the geriatric patient	Randomised, controlled intervention study	Denmark	It was concluded the most effective way to reduce the inappropriate prescribing was combined interactive education meeting plus recommendations given by clinical pharmacists.
22	Providing feedback to hospital doctors about prescribing errors; a pilot study (Franklin et al, 2007)	To assess the feasibility and acceptability of obtaining data on prescribing errors and presenting feedback	Incident reporting and retrospective review and providing feedback	UK	This study was found out that incident reporting for prescribing error was gross to under-reporting. Besides, consultants in the hospital found the feedback was helpful to them.
23	The effect on medication errors of pharmacists charting medication in an emergency department (Vasileff et al., 2009)	To evaluate the impact of pharmacist's role reducing medication errors	Observation and comparison two methods	Australia	Pharmacist charting medication provide an opportunity prior patient seeing doctor provide significant reduction of medication errors.

Table 2.1 *continued*

No	Study title	Focus	Study design	Regional focus	Finding
The strategies of reducing prescribing errors ( education interventions)					
24	Medication error prevention by pharmacists- an Isreali solution (Lustig, 2000)	To assess the impact of pharmacist intervention in preventing potential harm	Prospectively recorded the frequency of medication errors	Isreal	60.6% of medication errors were prescribing errors and the most common error was inappropriate dosage. Pharmacist succeeded prevented 73.8% of the error cases especially dosage change.
Define the inappropriate medication prescribing in elderly					
25	Updating the Beers Criteria for potentially inappropriate medication use in older adults (Fick et al., 2003)	Revised and updated Beers criteria	Delphi method	USA	Updated the established criteria. Some medicines have added or dropped from the criteria 2002
26	Defining inappropriate practices in prescribing for elderly people: a national consensus panel (McLeod et al., 1997)	To develop a list of inappropriate practices in prescribing for geriatric population	Survey	Canada	The study was focus on develop a list of inappropriate prescribing drug which should be aware and avoid in the geriatric patient. The drug classes were including cardiovascular diseases, psychotropic drug and NSAIDs and analgesics.
Malaysia gerontology issues and challenges					
27	Services for older people in Malaysia: issues and challenges (Philip J.H.P, Forsyth D.R, Daniel K.Y.C, 2004)	Discussing the issues and challenges of geriatrics service in Malaysia	Literature review	Malaysia	It should develop an integrated approach to the care of the elderly and recognise any ethnogenic factors that will influence future health and social care needs.

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 Study Design**

The study was an experimental study which involved interventions with the subjects. It involved two phases. The pre-phase was a retrospective observation of prescriptions to identify the characteristics of the prescribing errors. The post-phase was conducted after implementation of the interventions and took a historical prospective, reviewing prescriptions to evaluate the effectiveness of the outcome.

This study was conducted without a control group. The reason for this was that it was impossible to conduct the study in two different healthcare clinics because different healthcare institutes make significantly different types of prescribing errors, even within the same field (Shah et al., 2001). Likewise, it would have been illogical to separate prescribers in the same setting into two groups: an exposure and a control group. Had the prescribers been separated into these groups, it would have been impossible to introduce the improving strategies. Furthermore, the total number of subjects in the hospital was small.

The subjects of the study were the prescriptions written by prescribers at Kuala Kangsar Hospital. The prescription writing was observed throughout the study period to evaluate the characteristics of the prescribing errors. More importantly, the prescribers were not aware of the study to avoid them purposely changing their prescription writing behavior during the study and providing a biased outcome.

### **3.1.1 Outcome measurement**

The frequency distribution of the prescriptions according to patients' demographic data, including their age and gender, was measured in both phases. In addition, the frequency distribution of the characteristics of the prescribing errors was also measured in both phases. The effectiveness of the interventions was measured according to the reduction in the rate of prescribing errors in the three categories of prescribing errors: omission errors, skill-based errors and knowledge-based errors. Commission error was excluded because it is unable to identify from the prescription if using the current study design.

The reduction in the total baseline prescribing errors was also evaluated. This varied from the literature review by 2-30% (Burmester, Dionne, Thiagarajan & Laussen, 2008; Meyer, 2000; Peeters & Pinto, 2009; Thomas, Boxall, Laha, Day & Grundy, 2008). The reduction rate was dependent upon the number of times an intervention plan had been introduced to the setting (Peeters & Pinto, 2009; Thomas et al., 2008). Since it was the first time that Kuala Kangsar Hospital had introduced a plan to reduce prescribing errors, the target was to reduce total baseline prescribing errors by 10%.

Additionally, the ratio of prescriptions with and without prescribing errors was evaluated in both phases to identify the total number of error-free prescriptions. The odds ratio for prescribing errors experienced by elderly patients was measured in the pre-phase to identify the risk of elderly patients experiencing the adverse effects of errors. The correlation between diseases and medication in elderly patients and prescribing errors was measured. The Risk Assessment Index which developed by the National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP), which is an independent body at United State to address the



interdisciplinary cause of errors and promote the safe use of medications, was used to evaluate the severity of error in the pre-phase. The degree to which pharmacists prevent prescribing errors was also measured in this study during the pre-phase by evaluating the rate and ratio of prescribing errors prevented by pharmacists.

### **3.1.2 Defining and establishing data elements**

A comprehensive review of the literature provided information to help draft the criteria for prescribing errors (Burmester et al., 2008; Dean et al., 2000; Devine et al., 2007). The previously stated definition of prescribing errors, developed by Dean et al. (2000), was used in the present study.

A standardized approach to identifying prescribing errors is set out in Table 3.1 to evaluate their characteristics. The severity of every prescribing error identified was evaluated using the Risk Assessment Index published by National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) which defines medication errors as any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient or consumer. Since one of the medication errors mentioned is prescribing errors, the index was suitable for use in evaluating the severity of the prescribing errors in the present study. The Risk Assessment Index divides the severity into nine categories, ranging from 'A' to 'I', with 'I' the most severe which shown in Table 3.2.