

**THE ROLE OF PHARMACIST IN
PRESCRIBING ERROR INTERVENTIONS IN
MALAYSIAN PUBLIC HEALTHCARE
INSTITUTIONS**

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PUBLIC HEALTHCARE INSTITUTIONS**

by

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PERANAN AHLI FARMASI DALAM INTERVENSI RALAT PRESKRIPSI DI INSTITUSI KESIHATAN AWAM MALAYSIA

ABSTRAK

Kesilapan preskripsi adalah penyebab utama kemudaratan kesihatan yang dapat dielakkan dalam penjagaan kesihatan di seluruh dunia. Di Malaysia, kesilapan preskripsi sering berlaku di kemudahan penjagaan kesihatan kerajaan. Ahli farmasi memainkan peranan penting dalam menyemak dan campurtangan dalam preskripsi sebelum mengeluarkan ubat. Di Malaysia, hubungan antara bilangan ahli farmasi dan jumlah intervensi yang dilakukan terhadap kesilapan preskripsi di pelbagai tetapan masih kurang difahami. Kajian ini bertujuan untuk memahami peranan ahli farmasi dalam menguruskan dan mengurangkan kesilapan preskripsi di pelbagai negeri di Malaysia. Secara khusus, kajian ini akan meneliti kelaziman dan corak kesilapan preskripsi, menyiasat intervensi yang dilakukan oleh ahli farmasi, dan menilai kesan intervensi tersebut terhadap keselamatan pesakit dan hasil penjagaan kesihatan. Sebuah kajian keratan lintang retrospektif menganalisis data dari Borang Pengurusan Farmasi Kementerian Kesihatan (Borang PF) dan Pendaftaran Lembaga Farmasi Malaysia antara tahun 2017 hingga 2019. Analisis regresi multivariat dijalankan untuk menentukan hubungan antara bilangan ahli farmasi, jumlah preskripsi yang diterima, dan bilangan kesilapan preskripsi yang dicampurtangi. Analisis ANOVA dua hala juga dijalankan untuk membandingkan bilangan intervensi ahli farmasi bagi setiap jenis kesilapan preskripsi di tiga tetapan berbeza: Farmasi Pesakit Luar Klinik Kesihatan, Farmasi Pesakit Luar Hospital, dan Farmasi Pesakit Dalam Hospital serta tahap keparahan. Setiap tahun, jumlah purata

sebanyak 1,355,170 (1.8% daripada jumlah preskripsi yang diterima setiap tahun) intervensi ahli farmasi atas kesilapan preskripsi dilaporkan dengan dos salah (n=308,549, 22.8%), ubat salah (n=242,821, 17.9%) dan kekerapan dos salah (n=149,289, 11.0%). Hubungan positif yang signifikan antara bilangan ahli farmasi, jumlah preskripsi yang diterima, dan jumlah intervensi atas kesilapan preskripsi ditemui. Tidak ada perbezaan yang signifikan secara statistik dalam bilangan intervensi di tetapan yang berbeza dan tahap keparahan. Ini menunjukkan bahawa ahli farmasi memainkan peranan aktif dalam menangani isu berkaitan ubat, tanpa mengira konteks atau keparahan. Kesimpulannya, peningkatan bilangan ahli farmasi dan jumlah preskripsi yang diterima adalah petunjuk penting peningkatan bilangan kesilapan preskripsi yang dicampurtangi di Malaysia. Penyelidikan ini memberikan pandangan berharga tentang peranan penting ahli farmasi dalam mengurangkan kesilapan preskripsi dan meningkatkan keselamatan pesakit dan kualiti penjagaan kesihatan di Malaysia secara keseluruhan.

THE ROLE OF PHARMACIST IN PRESCRIBING ERROR INTERVENTIONS IN MALAYSIAN PUBLIC HEALTHCARE INSTITUTIONS

ABSTRACT

Prescribing errors are a major cause of avoidable harm in healthcare worldwide. In Malaysia, prescribing errors are prevalent in public healthcare facilities. Pharmacists play a vital role in screening and intervening in prescriptions before dispensing medications. In Malaysia, the relationship between the number of pharmacists and the total number of interventions conducted on prescribing errors across different settings remains poorly understood. This study aims to understand the role of pharmacists in managing and reducing prescribing errors across different states in Malaysia. Specifically, it seeks to explore the prevalence and patterns of prescribing errors, investigate the interventions made by pharmacists, and assess the examine the association between these interventions and patient safety and healthcare outcomes.. A retrospective cross-sectional study analyzed data from the Ministry of Health's Pharmacy Management Form (PF form) and the Pharmacy Board Registry between 2017 and 2019. A multivariate regression analysis was conducted to determine the association between the number of pharmacists, total prescriptions received, and the number of prescribing errors intervened. A two-way ANOVA analysis was also performed to compare the number of pharmacist interventions for each type of prescribing error across three different settings: Health Clinic Outpatient Pharmacy, Hospital Outpatient Pharmacy, and Hospital Inpatient Pharmacy as well as severity levels. Annually, a total mean of 1,355,170 (1.8% from total prescriptions received annually) pharmacists' interventions on prescribing errors were reported with

wrong dose (n=308,549, 22.8%), wrong medication (n = 242,821, 17.9%) and wrong dosing frequency (n = 149,289, 11.0%). Significant positive association between the number of pharmacists, total prescriptions received, and the total interventions on prescribing errors were found. There were no statistically significant differences in the number of interventions across different settings and level of severity. This suggests that pharmacists are playing an active role in addressing medication-related issues, regardless of the context or severity. In conclusion, an increasing number of pharmacists and total prescriptions received are significant predictors of an increased number of prescribing errors intervened in Malaysia. The research provides valuable insights into the crucial role of pharmacists in mitigating prescription errors and improving overall patient safety and healthcare quality in Malaysia.

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter provides an overview of the current research focus. Specifically, it highlights the background of pharmacists' interventions in prescription management and their critical role in improving healthcare outcomes. Subsequent sections will delve into the problem statement, research objectives, definitions of key terminologies, and the theoretical framework underpinning this study.

The current research, titled "Role of Pharmacists' Interventions In Improving Healthcare Outcome: Retrospective Study On Intervention Of Prescribing Errors In Malaysia," is of paramount importance in the contemporary healthcare landscape of Malaysia. Given the significant implications of prescribing errors on patient safety and healthcare efficiency, understanding the interventions of pharmacists in this context is crucial. This research seeks to shed light on the nature, frequency, and outcomes of such interventions, specifically focusing on their impact on reducing prescribing errors in Malaysia.

1.2 Research background

The global population is steadily aging worldwide. The United Nations defines individuals aged 60 years and older as being part of the aging population. By the year 2030, it is projected that one out of every six individuals globally will be 60 years old or older. The demographic segment aged 60 and above is projected to grow from 1 billion in 2020 to 1.4 billion by 2030. By 2050, the population over 60 is expected to double to 2.1 billion. Furthermore, the number of people who are 80 years old or older is predicted to triple from its 2020 figures, reaching 426 million by 2050. ¹

As individuals grow older, they tend to be susceptible to health conditions, especially non-communicable diseases (diseases that are not spread through infection or through other people) such as cardiovascular diseases, cancers, diabetes, and chronic respiratory diseases. ² According to the World Health Organisation (WHO), noncommunicable diseases (NCDs) are responsible for 41 million deaths yearly, which constitutes 74% of all global deaths. Every year, 17 million people die from an NCD before reaching the age of 70, with 86% of these early deaths occurring in low- and middle-income countries. Notably, 77% of all NCD-related deaths happen in these countries. The leading causes of NCD deaths are cardiovascular diseases, causing 17.9 million deaths annually, followed by cancers (9.3 million), chronic respiratory diseases (4.1 million), and diabetes (2.0 million, including diabetes-induced kidney disease deaths). The National Health and Morbidity Survey (NHMS) conducted in 2019 revealed that in Malaysia with a population of 32.8 million, approximately 3.9 million adults were diagnosed with diabetes, about 6.4 million had hypertension, around 8 million were found with hypercholesterolemia. And out of these figures, 3.4 million Malaysians have two NCDs whereas a staggering 1.7 million Malaysians live with three NCDs. Together, these disease categories represent over 80% of all

premature NCD deaths.^{3,4} The increasing aged demographic poses substantial challenges to global health, evidenced by the heightened demand for healthcare resources, a broader range of healthcare needs, and often inadequate responses from health systems.⁵

This matter also translates into a rapid ascent of medication consumption, paired with a rise in increasingly complex medication treatments.^{3,6,7} Nearly 90% of individuals under the aging population routinely use at least one prescription medication, about 80% are on a minimum of two different prescription drugs regularly, and 36% of them regularly manage a regimen of five or more different prescription medications.⁸ This results in a significant increase in medication usage, potentially leading to medication errors that cause adverse outcomes such as adverse drug reactions (ADRs), drug-drug interactions, ineffective treatment, poor patient compliance, and reduced quality of life and patient satisfaction. Consequently, these factors can lead to substantial health and economic ramifications, such as heightened utilisation of healthcare facilities, avoidable hospitalisations due to medication-related issues, and even mortality.^{9,10}

1.2.1 *Medication error*

One must first define what a medication, medicine, or drug is before attempting to define a medication error or an adverse drug reaction. A medication, also referred to as a medicinal product, is defined as 'a product containing an active ingredient, typically a drug or prodrug, but which may also include cellular elements, excipients, or contaminants.'¹¹ As per a codicil to this definition, a medicinal product is defined

as one that is meant to be taken or administered to an individual or animal for one or more of the following purposes: as a placebo; to prevent an illness; to diagnose; to test for potential side effects; to alter a physiological, biochemical, or anatomical function or abnormality; to substitute a missing component; to relieve a symptom; to treat an illness; or to induce anesthesia. Giving a patient a medication (the object) for any of these reasons is known as medication (the process). ¹¹ Under the Sales of Drugs Act (SODA) 1952, a drug includes any substance, product or article intended to be used or capable, or purported or claimed to be capable, of being used on humans or any animal, whether internally or externally, for a medicinal purpose. ¹² “Medicinal purpose” here refers to any of the following purposes: (a) alleviating, treating, curing or preventing a disease or a pathological condition or symptoms of a disease; (b) diagnosing a disease or ascertaining the existence, degree or extent of a physiological or pathological condition; (c) contraception; (d) inducing anaesthesia; (e) maintaining, modifying, preventing, restoring, or interfering with, the normal operation of a physiological function; (f) controlling body weight; (g) general maintenance or promotion of health or wellbeing. ¹²

Based on a systematic review that examines the definition and attributes of medication errors, it has been found that there exist a minimum of 26 distinct generic definitions of medication errors. ¹³ The National Coordinating Council for Medication Errors Reporting and Prevention (NCC MERP), a widely recognised authority on the subject, provides the most thorough definition. They defined 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 health care professional, patient, or consumer. Such events may be related to professional practice, health care

products, procedures, and systems, including prescribing, order communication, product labeling, packaging, and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use.”^{14,15}

1.2.2 *Types of medication errors*

Medication error can be categorised into different types, including transcribing error, dispensing error, administering error, monitoring error and prescribing error.¹⁵ Transcribing error is defined by Shawahna et al as any discrepancy between the physician medication order and the medication order transcribed onto any document related to the patient concerned as the medical record, medication chart, medication request sheet, discharge medication chart and/or any other similar document.¹⁶ A dispensing error occurs when there is a discrepancy between a prescription and the medication dispensed to the patient or distributed to the ward, which may include dispensing medications of inferior pharmaceutical or informational quality.¹⁷ A medication administration error (MAE) is defined as a failure in one of the ten “rights” of medication administration. These rights include ensuring the right patient, right medication, right time, right dose, right route, right education/advice, rights to refuse, right assessment, right evaluation/response, and documentation. Administration errors can cause serious potential harm to patients, especially when they incur via the intravenous route.¹⁸ Monitoring error can be explained as a failure to review a prescribed regimen for appropriateness, or failure to use appropriate clinical or laboratory data for adequate assessment of resident response to prescribed therapy.¹⁹ Last but not least, a prescribing error in simple terms is 'a failure in the prescription writing process that results in a wrong

instruction about one or more of the normal features of a prescription' or a preventable event that takes place when a prescription is written or carried out in a manner that decreases the medication's effectiveness or elevates the risk of harm to the patient. Factors contributing to prescribing errors may include lack of knowledge, communication issues, or systemic errors within the healthcare setting. A more detailed examination of prescribing errors will be presented in Chapter 2.²⁰

1.2.3 *Cost of medication errors*

Medication errors are a leading cause of preventable harm in healthcare worldwide, costing an estimated \$42 billion annually. This amounts to nearly 1% of the global health expenditure.²¹ One systematic review revealed that mean costs per medication error towards the healthcare system ranged from €2.58 to €111 727.08.²² A separate study revealed that England experiences an estimated 237 million instances of medication errors annually, with 66 million of these having the potential to be clinically significant. The government incurs an annual expense of £98.5 million due to preventable adverse reactions to medication. This includes adverse drug events (ADEs) in primary care that result in hospitalisation (£83.7 million; causing 627 deaths), as well as ADEs in secondary care that prolong hospital stays (£14.8 million; causing or contributing to 1081 deaths).²³ In the United States it was estimated that one medication error occurs per hospitalised patient per day and each day someone dies from medication error.^{24,25} In a study conducted by Samsiah et al. in Malaysia, it was found that medication errors constituted 0.025% of all prescriptions dispensed at healthcare facilities. Within these errors, 1.9% resulted in harm, with four instances proving fatal for the patients. Notably, the incidence of reported medication errors in

many countries has been on the rise over the years: for example a previous report by the Poison Information Centre (PIC) in Finland indicates a significant increase in medication errors within the healthcare system between year 2000-2007.²⁶ In Malaysia where the reporting for medication error is voluntary via the Medication Error Reporting System (MERS), it was also shown that it has been on the rise over the years whereby it increased from 2626 reports in 2009 to 5770 reports in 2012.^{27,28}

1.2.4 *Systematic medication errors*

Medication errors can arise not only from patient-related factors but also from deficiencies in medication systems, healthcare worker-related issues, and workplace conditions. Instances of medication system inadequacy encompass the perplexing nomenclature, labelling, and packaging of medicines. Healthcare worker related factors include insufficient therapeutic training, inadequate understanding of medications, limited patient knowledge, insufficient risk perception, overworked or fatigued healthcare professionals, physical and emotional health issues, and ineffective communication among healthcare professionals and with patients. Work environment factors encompass various examples such as high workload and time constraints, distractions and interruptions from both staff and patients, absence of standardised protocols and procedures, inadequate resources, and challenges with the physical work environment, such as lighting, temperature, and ventilation. Healthcare professionals who are directly or indirectly involved in such adverse events, commonly referred to as "second victims," may suffer substantial emotional harm as a result.^{14,15}

1.2.5 *A call for action*

Given the significant global impact of medication errors, as demonstrated by various studies and reports, they have emerged as a critical concern in patient safety initiatives worldwide. This is exemplified by the World Health Organisation's (WHO) commitment, as seen in the launch of the Global 2021-2030 and the adoption of a resolution on global action on patient safety at the seventy-second World Health Assembly in 2019, where it urged Member States – and, where applicable, regional economic integration organisations – inter alia, to recognise patient safety as a health priority in health sector policies and programmes, emphasising a concerted international effort to address such critical healthcare challenges. Under Strategy 3.2, WHO calls for governments to promote the reporting of adverse drug (medication) events and medication errors. Meanwhile, WHO will work towards assisting countries in setting up and enhancing systems for reporting medication errors, as well as reinforcing the involvement of multi-professional teams in ensuring medication safety.²¹ Malaysia has consistently prioritised patient safety and established the Patient Safety Council of Malaysia in January 2003, in response to a directive from the Malaysian Cabinet. The council's purpose is to ensure that citizens receive healthcare that is safe. The Director General of Health Malaysia chairs this council, which provides advice to the Honourable Minister of Health on preventable adverse events and the corresponding measures implemented to address them. The council aims to enhance the safety and quality of healthcare in Malaysia by promoting systemic improvements. In response to the World Health Organisation's call in 2019, the Council introduced guidelines on Malaysian Patient Safety Goals 2.0. These

guidelines include Key Performance Indicators (KPIs) set by the Ministry of Health to be achieved on an annual basis. One of these KPIs, known as KPI 5 under goal number 3, focuses on the collection of data on medication errors that result in severe harm or death.²⁹ With the National Patient Safety Council at the forefront of the Patient Safety agenda in Malaysia, it is expected that healthcare workers will assume responsibility to prioritise patient safety by implementing all necessary measures.³⁰

1.2.6 *Pharmacist*

A pharmacist is a licensed healthcare professional authorised to practice pharmacy. Their responsibilities encompass various aspects of medication handling, including dispensing prescription drugs, monitoring drug interactions, administering vaccines, and providing counseling to patients about the effects and proper use of drugs and dietary supplements.^{31,32} They are also involved with the composition, properties, interactions, proper use, and distribution of medicines.³³ Moreover, pharmacists are authorised to prepare, compound, and dispense drugs based on prescriptions from licensed practitioners such as physicians, dentists, or advanced practice nurses. They often collaborate with, consult, and sometimes advise the prescribing practitioner concerning drugs.³⁴ Therefore, pharmacists play a crucial role in guaranteeing the safety of medications throughout the entire process of care. The intricate nature of the medication prescribing, and delivery processes can pose challenges in directly establishing the positive impact of pharmacists on adverse outcomes. However, research has demonstrated that pharmacist involvement effectively reduces errors, enhances prescribing practises, and improves patient monitoring in various healthcare settings.³⁵ An illustrative instance is a cluster-randomized trial that examined the impact of pharmacist participation in medication

management planning during hospital admission. The trial revealed a significant decrease in medication errors within the initial 24 hours of hospitalisation.³⁶ A meta-analysis of 13 studies of pharmacist interventions at transitions of care estimated a 37% reduction in medication errors and a decrease in emergency department visits after hospital discharge.³⁷

In the context of healthcare, an intervention is a set of activities or strategies aimed at assessing, improving, maintaining, promoting, or modifying health among individuals or a population. Interventions may include programs for education or care, policy changes, environmental enhancements, or health promotion campaigns. Such interventions can be complex when they include multiple independent or interacting components, and their effectiveness can be influenced by the context in which they are delivered, such as in communities, workplaces, homes, schools, or hospitals.³⁸

Specifically, a pharmacist intervention is any action taken by a pharmacist during the dispensing process involving a prescriber or a patient, with the goal of rationalizing drug prescribing or use. This can include ensuring the appropriateness of pharmacotherapy, indication, and medication, determining the correct dose according to the patient's clinical condition, appropriate administration and duration of treatment, ensuring patient adherence to treatment, and monitoring the outcomes of pharmacotherapy as well as possible adverse drug-to-drug reactions.³⁹

The roots of pharmacy can be traced back to ancient civilizations. The oldest known pharmaceutical records date back to around 2600 BC in ancient Mesopotamia,

where prescriptions were recorded on clay tablets. In ancient Greece and Rome (500 BC - 500 AD), individuals like Hippocrates, Dioscorides, and Galen laid the foundations for medicinal practice and pharmacology. Apothecaries, the precursors to modern pharmacists, began to emerge, preparing and selling medicinal substances. During the medieval period (500 AD - 1500 AD), apothecaries continued to evolve in the Islamic world and Europe. Islamic scholars like Avicenna made significant contributions to the advancement of pharmacy and medicine. The Renaissance period (14th - 17th Century) saw the separation of pharmacy and medicine as distinct professions. The first official pharmacopoeia (a book containing directions for the identification of compound medicines) was published in Florence in 1498.⁴⁰

1.2.7 *Origin of pharmacy*

The first pharmacy school, the Philadelphia College of Pharmacy, was established in 1821 in the United States. This institution is recognised as America's first pharmacy school, and it played a significant role in the evolution of pharmacy education and the profession itself. This institution set the stage for the development of pharmacy as a distinct profession, separate from medicine.⁴¹

Before delving into the history of pharmacy in Malaysia, it is essential to understand the broader landscape of the Malaysian healthcare system. Malaysia possesses a dichotomous healthcare system that encompasses both a public healthcare system and a private healthcare system. Typically, these two sectors function independently, but the public sector has implemented multiple outsourcing initiatives with the private sector, particularly in response to the COVID-19 pandemic. The

public sector seeks to provide widespread coverage of universal healthcare for the population, delivering virtually near-free primary healthcare services and heavily subsidised secondary and tertiary care services which is largely funded by federal government revenues. The private sector aims to offer healthcare services to the general population through a fee-for-service model. This is primarily financed by individual out-of-pocket payments and private health insurance, which may also cover employee benefits.⁴² Separation of prescribing and dispensing only occurs at public healthcare facilities whereas in private healthcare facilities, especially at primary care clinics, medical practitioners still do their own medication dispensing. This is unlike in developed countries like Australia or United Kingdom whereby pharmacists have full dispensing rights and doctors do not dispense medicines generally. Implementing a separation between the tasks of prescribing and dispensing would eliminate the conflicting interests of physicians who could benefit financially from both prescribing and selling drugs. Additionally, it would establish a system of checks and balances to prevent excessive prescribing practices. Following the implementation of the dispensing separation policy in Korea, there was an immediate decrease of nearly 5% in the quantity of prescribed medication. The second justification for implementing a dispensing separation is the significant likelihood of medication errors committed by physicians, which can have serious consequences if not addressed. These errors may arise from simple omissions, such as neglecting to include the patient's name or due to illegible handwriting. Alternatively, they may stem from more severe causes, such as prescribing medication that is contraindicated for the patient.⁴³

1.2.8 *Evolution of pharmacist in the country*

The roles of pharmacists and pharmacy services in Malaysia began to take shape around 1951 with the enactment of key legislation, including the Registration of Pharmacists Act 1951, the Poisons Act 1952, and the Dangerous Drugs Act 1952. Initially, the pharmacy service was mainly about procurement, storage, and distribution of drugs from the United Kingdom. During the Second Malaysia Plan spanning from 1961-1965, a pivotal facility known as the Government Pharmaceutical Laboratories and Stores (GPLS) Complex was inaugurated in Petaling Jaya in 1969. This establishment played a crucial role, ensuring the availability of affordable, efficient, and high-quality drugs, especially for the Ministry of Health's rural health initiatives.

In 1969, also saw the introduction of the Pharmaceutical Chemistry Division, addressing the growing demands of pharmacy services. Initially, the title for professionals in this field was "Pharmaceutical Chemistry Superintendent". However, by 1974, the division evolved and was renamed the Pharmaceutical Services Division, highlighting its growing significance in the healthcare realm. By 1976, to bolster the efficiency of regulatory oversight related to pharmaceuticals, the Pharmacy Enforcement Unit was established under the Pharmaceutical Services Division. The 1970s brought in a renewed focus on ensuring the quality of drugs in the nation. This mission was taken up by the National Pharmaceutical Control Laboratory, instituted in 1978. It would later adopt the title National Pharmaceutical Control Bureau. 1984 was a pivotal year in shaping Malaysia's drug regulations. The Control of Drugs and Cosmetics Regulations unveiled in June of that year paved the way for a structured pharmaceutical oversight mechanism in the nation. Subsequently, in 1985, the Drug Control Authority (DCA) was formed under the supervision of the Director General

of Health Malaysia. Tasked with the vital responsibility of vetting the quality, safety, and efficacy of medicines, the DCA, aided by the National Pharmaceutical Control Bureau, embarked on critical roles like product registration, inspections, surveillance, and monitoring adverse drug reactions.

Going back to 1952, under the 1951 Registration of Pharmacists Act, the Pharmacy Board registered its first batch of 20 pharmacists. By 1957, the public sector had 23 registered pharmacists. Recognising the acute shortage of pharmacists and the ensuing need to sustain essential pharmaceutical services in public health facilities, a temporary solution was initiated in the form of the Dispenser's Training School, later renamed the Pharmacy Assistant Training School. The nation still grappled with a scarcity of pharmacists, impacting the broadening of pharmacy services, particularly in delivering clinical and pharmaceutical care. To address this long-standing challenge, 2003 saw an amendment to the Registration of Pharmacists Act 1951, making it mandatory for pharmacists to serve in the public sector. This amendment was put into practice on 2nd September 2004. Fast forward to today the Pharmaceutical Services Division is once again renamed to Pharmaceutical Services Program (PSP), with four main divisions namely Pharmacy Policy & Strategic Division, Pharmacy Practice & Development Division, Pharmacy Enforcement Division and National Pharmaceutical Regulatory Division to oversee the ever growing pharmacy profession in Malaysia. ⁴⁴

1.2.9 *The pharmacy today*

The pharmacy sector in Malaysia is well-established with a total of 21,760 registered pharmacists as of 2022. The distribution of these pharmacists is quite diverse with around 13,000 pharmacists working in the government sector, including military pharmacy and university hospitals, and 6,364 pharmacists operating in community and wholesale pharmacies. The remaining pharmacists are engaged in various other fields like pharmaceutical companies, academia, and maritime pharmacy.⁴⁵

In comparison to other countries in Asia, Korea had over 74,000 pharmacists in 2021, with a notable proportion working in community pharmacies.^{46,47} Conversely, Indonesia recorded around 77,191 registered pharmacists in 2019 and 70.8% of pharmacists in Indonesia work in a primary healthcare sector.⁴⁸ Taiwan's pharmaceutical workforce comprised nearly 36,000 pharmacists. In a 2015 nationwide survey, it was found that 82% of pharmacists were employed in Medical Institutions, while a smaller percentage of 16% were engaged in the pharmaceutical industry. Among the pharmacists working in medical institutions, 26% were hired by physicians in clinics. Additionally, 34% operated in community pharmacies, and only 22% were stationed in hospitals.^{49,50} Based on the data from 2018, out of roughly 310,000 pharmacists in Japan, around 180,000 are engaged as community pharmacists and 54,000 serve as hospital pharmacists. The remaining pharmacists are distributed among pharmaceutical wholesalers, manufacturers, distributors, universities, and other various sectors. As of April 2022, India boasts a total of 1,686,342 registered pharmacists, marking a significant professional cadre within the healthcare sector. However, the journey to this point reflects a mix of regulatory evolution and ongoing challenges. Prior to 1984, the regulatory framework allowed individuals without

formal pharmacy educational qualifications to register as pharmacists, provided they had accrued five years of experience in compounding and dispensing drugs. This landscape has since shifted, but contemporary challenges persist. A notable concern is the operational ethos of many pharmacies, which, as revealed by a 2005 study, often function without an on-site pharmacist—nearly 50% of pharmacies fell into this category. This issue is further compounded by a prevalent practice among pharmacy owners, many of whom are not pharmacists themselves, of hiring pharmacists on a token/rent basis. This arrangement often results in pharmacists being unavailable for dispensing medications, thereby undermining the critical role they are poised to play in healthcare delivery.⁵¹

Additionally, other countries in the region also present notable data. Singapore had around 3,769 pharmacists, comprising 2,878 local-trained pharmacists and 891 foreign-trained pharmacists in 2021, reflecting a smaller yet well-regulated pharmacy sector.⁵² In 2023, the Philippines saw the number of registered pharmacists touch roughly 30,000, distributed sparsely across communities, hospitals, and various institutions.⁵³ Thailand had around 42,060 pharmacists registered in 2019, but only 29,000 are in the active workforce. The majority of them work in hospitals followed by community pharmacies while only 16% work in industry.⁵⁴

1.3 Problem Statement

Prescribing errors (PEs) account for 24-76% of all medication errors, as evidenced by multiple studies, establishing them as a critical concern within healthcare systems globally. These errors have far-reaching consequences, such as significantly

prolonging patients' hospital stays, inflating healthcare costs, and contributing to increased mortality rates.^{27,28,55} In response to the World Health Organisation's (WHO) global call for improved patient safety, the Ministry of Health Malaysia has developed the "Quick Guide in Preventing Prescription Error" to reinforce their commitment to patient safety and addressing the issue of prescribing errors.²⁸

Despite these efforts, the bulk of research focused on pharmacists' responsibilities in identifying and addressing prescribing errors in Malaysia has been restricted to specific locations, limiting the ability to generalize findings to the entire country. Most studies conducted in Malaysia have only captured data from individual hospitals or clinics, creating a gap in understanding the national impact of pharmacists' interventions (which will be explored further in Chapter 2). This limitation underscores the need for broader, nationwide data that can effectively demonstrate the significance of pharmacists' roles in reducing and mitigating prescribing errors across various regions and healthcare settings.

1.4 Rational and significance of The Research Project

To address these gaps, this study aims to conduct a nationwide analysis of pharmacist interventions in prescribing errors. The growing emphasis on prescribing errors, coupled with the increasing demands of a growing and aging population, highlights the urgency of assessing the capacity of the pharmacist workforce to manage the rising volume of prescriptions. While technological interventions like electronic prescribing, medication error surveillance systems, and barcode medication

administration have been implemented, they cannot replace the critical oversight provided by pharmacists in ensuring medication safety.¹⁴ Pharmacists play a central role in reviewing and verifying prescriptions to prevent errors that could harm patients. Their interventions are vital in maintaining high standards of patient care and medication safety throughout the healthcare continuum. Therefore, a comprehensive analysis of the relationship between the number of pharmacists and the volume of prescriptions they manage is essential. This study seeks to determine whether the current pharmacist workforce is sufficient to meet the rising demands of healthcare services while maintaining optimal medication safety practices. Building upon existing research, such as the study by Suzuki et al., which examined the correlation between the number of pharmacists and the frequency of prescription interventions, this study will expand the scope to a nationwide level. The insights gained will contribute to pharmacist workforce planning and policy development within Malaysia's healthcare system. This research aims to provide evidence-based recommendations that will optimize the role of pharmacists, enhance patient safety, and improve healthcare outcomes across the country.⁵⁶

1.5 Research objectives

The primary aim of this research is to understand the role of pharmacists in enhancing patient safety and improving the quality of healthcare in Malaysia, specifically through their ability to detect prescribing errors. By exploring the **relationships** between pharmacists' interventions and the occurrence of prescribing errors, this research seeks to clarify the **associations** between these variables. Furthermore, the study aims to assess the health outcomes of these interventions in

mitigating prescribing errors, ultimately providing insights into their broader implications for healthcare quality and patient safety.

To clarify:

1. **Relationship** refers to the connection or interaction between pharmacists' interventions and prescribing errors. This involves understanding how pharmacists' actions are linked to the occurrence and detection of errors.
2. **Association** refers to the statistical correlation between pharmacists' interventions and prescribing errors. The focus here is on determining whether a pattern or link exists, without necessarily implying causality.

The specific objectives of this research are:

- i. To understand the pattern of reported prescribing error in public healthcare service across different regions in Malaysia.
- ii. To identify the role of pharmacist in intervening the reported prescribing errors.
- iii. To assess the extent to which pharmacists' interventions contribute to reducing prescribing errors and enhancing medication safety in Malaysia.

A foundational understanding is sought to be established through this research, which can guide future assessments and gauge the effectiveness of current pharmacists' interventions in Malaysia's healthcare system. Ultimately, the overarching goal is to

propose intervention strategies tailored to the specific needs and circumstances of the Malaysian healthcare system, ensuring optimized pharmacist involvement and improved healthcare outcomes.

Healthcare outcomes are the results that stem from healthcare services or interventions, focusing on the impact on patient health over time. These outcomes encompass not just the immediate health status or quality of life of patients but also include broader implications such as the ability to live normal, productive lives, changes in patient, provider, and population attitudes and behavior, and the advancement of medical knowledge through new evidence and research. Outcomes also refer to the efficiency and quality improvements within healthcare organisations, aiming at cost targets and patient experience enhancements. Essentially, healthcare outcomes measure the change in health for individuals or populations directly attributed to medical interventions, capturing the full scope of effects that treatments and healthcare strategies have on people's lives.⁵⁷⁻⁵⁹

1.6 Research questions

A central inquiry of this research revolves around understanding the extent to which pharmacists' interventions impact healthcare outcomes, particularly in addressing prescribing errors within Malaysia's healthcare system. To delve deeper into this topic, the researchers have formulated three specific research questions:

- i. What are the patterns of reported prescribing errors in public healthcare services across different regions in Malaysia?
- ii. How do pharmacists in Malaysia intervene when confronted with reported prescribing errors?
- iii. How do pharmacists' interventions influence the frequency and severity of prescribing errors in Malaysia?

These questions will guide our research methodology and analysis, aiming to provide a comprehensive understanding of the role pharmacists play in enhancing healthcare quality and ensuring patient safety in the context of prescribing errors.

Hypotheses

In line with the research objectives and questions, the following hypotheses are proposed:

1. Pattern of Prescribing Errors (Objective i)

Hypothesis: The frequency and type of prescribing errors reported in public healthcare services vary significantly across different regions in Malaysia due to differences in healthcare infrastructure, resources, and regional practices.

2. Pharmacists' Role in Interventions (Objective ii)

Hypothesis: Pharmacists in Malaysia play a significant role in reducing the prevalence of prescribing errors by detecting and intervening in these errors across various healthcare settings.

3. Association Between Pharmacists' Interventions and Prescribing Error Reduction (Objective iii)

Hypothesis: Pharmacists' interventions significantly reduce both the frequency and severity of prescribing errors, thereby improving patient safety and healthcare outcomes in Malaysia.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter aims to present a comprehensive literature review, encompassing key areas pivotal to this study. The objective is to thoroughly explore existing literature, providing context and depth to our research questions. A systematic approach has been employed in selecting relevant studies, ensuring a broad yet focused review.

2.2 Prescribing Error

As defined by Dean et al., a clinically meaningful prescribing error occurs when, due to a prescribing decision or prescription-writing process, there is an unintentional and significant (1) reduction in the likelihood of timely and effective treatment or (2) an increase in the risk of harm compared to generally accepted practice.²⁰ In simpler terms a prescribing error refers to a mistake that happens during the process of recommending a medication to a patient. This was a validated healthcare practitioner led definition of prescribing error developed using a Delphi technique by Dean and her team.²⁰

The two-stage Delphi technique is used to gather the opinions of a group of knowledgeable judges. Consensus methods, like the Delphi method, are becoming more common in the development of clinical guidelines. The goal is to optimise the

advantages of having a panel of experts evaluate a problem while minimising the issue of one person dominating the group decision-making process. The Delphi technique involves participants expressing their level of agreement with a set of statements through a postal questionnaire. The scores are then compiled and presented to the participants in a subsequent version of the questionnaire, allowing them to reassess their scores based on the group's responses. Each participant's perspectives are given equal consideration, and the identity of each participant remains anonymous.²⁰

Dean and her colleagues broke down prescribing errors into three categories with each of these categories having further sub-sections. The categories or errors were error decision making, error in prescription writing and errors that were dependent on the individual's (or patient) clinical condition. The aforementioned categories serve as the foundation for numerous forthcoming studies that aim to define prescribing errors, including the present thesis. ²⁰