TRENDS OF MEDICATION ERRORS AND ITS ASSOCIATED FACTORS IN MALAYSIA: AN ANALYSIS FROM THE MEDICATION ERROR REPORTING SYSTEM, 2016-2023

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by

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LIST OF ABBREVIATIONS

ADR	Adverse Drug Reactions
ADE	Adverse Drug Events
AIC	Akaike Information Criterion
COVID	Coronavirus Disease
CPOE	Computerized Provider Order Entry
ED	Emergency department
ME	Medication Errors
CI	Confidence Interval
IV	Intravenous
GOF	Goodness of Fit
LR	Likelihood Ratio Test
SE	Standard Error
WHO	World Health Organization
MERS	Medication Error Reporting System
NCCMERP	National Coordinating Council on Medication Error Reporting and Prevention
PTSD	Post-Traumatic Stress Disorder

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POLA KESILAPAN PENGUBATAN DAN FAKTOR-FAKTOR BERKAITAN DI MALAYSIA: ANALISIS DARIPADA SISTEM PELAPORAN KESILAPAN PENGUBATAN, 2016-2023

ABSTRAK

Pengenalan: Menilai faktor-faktor yang menyumbang kepada kesilapan pengubatan adalah penting dalam sektor kesihatan, terutamanya di Malaysia, di mana kesilapan pengubatan membawa kepada kemudaratan kepada pesakit, peningkatan tempoh berada di hospital, peningkatan kos penjagaan kesihatan dan bahkan kematian. Kajian ini bertujuan untuk menerangkan trend kesilapan pengubatan di Malaysia dari 2016 hingga 2023 dan mengenal pasti faktor-faktor penyebab (faktor berkaitan kakitangan, faktor berkaitan ubat, faktor berkaitan tugas atau teknologi, faktor berkaitan tempat kerja atau persekitaran, masa dan lokasi kejadian) yang mempengaruhi jumlah bilangan kesilapan pengubatan di Malaysia. **Kaedah:** Kajian keratan rentas telah dijalankan berdasarkan data sekunder daripada Sistem Pelaporan Kesilapan Ubat Kebangsaan (MERS) dari Januari 2016 hingga Disember 2023. Semua kes yang memenuhi kriteria inklusi, yang melibatkan laporan kesilapan pengubatan daripada hospital dan klinik kerajaan di Malaysia dimasukkan, manakala kes dengan lebih daripada 20% data yang hilang untuk pembolehubah yang relevan telah dikecualikan. Trend kesilapan pengubatan dianalisis menggunakan analisis Joinpoint, dan faktor-faktor berkaitan dianalisis menggunakan analisis regresi Poisson. **Keputusan:** Daripada 377,089 laporan kesilapan pengubatan yang diperoleh daripada Sistem Pelaporan Kesilapan Pengubatan Negara (MERS) di seluruh Malaysia, sebanyak 372,916 laporan yang memenuhi kriteria telah dimasukkan dan dianalisis dalam kajian ini. Ciri-ciri umum kesilapan pengubatan menunjukkan bahawa faktor yang paling

kerap menyumbang kepada kesilapan adalah waktu puncak (24.9%), diikuti dengan gangguan (20.2%) dan kakitangan yang kurang berpengalaman (12.4%). Trend kesilapan pengubatan di Malaysia menunjukkan peningkatan yang signifikan dari Januari 2016 hingga April 2021 (APC 2.2%) tetapi menurun selepas itu (APC -1.1%). Faktor berkaitan yang signifikan termasuk kakitangan yang kurang berpengalaman (Adj. IRR=1.02; 95% CI=1.01, 1.02), pengetahuan yang tidak mencukupi (Adj. IRR=1.03; 95% CI=1.02, 1.03), gangguan (Adj. IRR=1.02; 95% CI=1.02, 1.03), ubat dengan nama yang hampir sama (Adj. IRR=0.98; 95% CI=0.98, 0.99), beban kerja yang berat (Adj. IRR=1.02; 95% CI=1.02, 1.03), waktu puncak (Adj. IRR=1.02; 95% CI=1.01, 1.02), kegagalan untuk mematuhi prosedur kerja (Adj. IRR=1.06; 95% CI=1.05, 1.06), maklumat atau rekod pesakit yang tidak tersedia atau tidak tepat (Adj. IRR=1.07; 95% CI=1.07, 1.08), kemasukan data komputer yang salah (Adj. IRR=1.02; 95% CI=1.01, 1.02), faktor lain (Adj. IRR=1.03; 95% CI=1.02, 1.03), lokasi kejadian di jabatan kecemasan (Adj. IRR=1.05; 95% CI=1.04, 1.05), di farmasi (Adj. IRR=0.95; 95% CI=0.94, 0.95), di wad (Adj. IRR=1.01; 95% CI=1.01, 1.01), dan di lokasi lain (Adj. IRR=1.04; 95% CI=1.01, 1.06). **Kesimpulan:** Kajian ini mendapati peningkatan keseluruhan dalam jumlah laporan berkaitan kesilapan pengubatan yang disebabkan oleh pelbagai faktor. Langkah-langkah seperti meningkatkan latihan untuk kakitangan kurang berpengalaman, mengurangkan gangguan, dan menangani beban kerja semasa waktu puncak berpotensi meningkatkan keselamatan pengubatan di Malaysia.

TRENDS OF MEDICATION ERRORS AND ITS ASSOCIATED FACTORS IN MALAYSIA: AN ANALYSIS FROM THE MEDICATION ERROR REPORTING SYSTEM, 2016-2023

ABSTRACT

Introduction: Assessing factors contributing to medication errors is crucial in healthcare settings, particularly in Malaysia, where medication errors lead to significant patient harm, prolonged hospital stays, increased healthcare costs and even fatalities. This study aimed to describe the trend of medication errors in Malaysia from 2016 to 2023 and to identify associated factors (staff-related factors, medication-related factors, task or technology-related factors, work or environment-related factors, time and location of events) that affected the number of medication errors in Malaysia. **Method:** A cross-sectional study was conducted using secondary data from the National Medication Error Reporting System (MERS) from January 2016 until December 2023. Cases that met the inclusion criteria, involving medication error reports from Malaysia's government hospitals and clinics, were included, while those with over 20% missing data for relevant variables were excluded. Medication error trends were analyzed using Joinpoint regression, and associated factors were examined using Poisson regression analysis. **Result:** Out of 377,089 medication error reports obtained from the National Medication Error Reporting System (MERS) across Malaysia, a total of 372,916 reports qualified to be included and were analyzed in this study. The general characteristics of medication errors showed that the most frequent contributing factors were peak hours (24.9%), followed by distraction (20.2%) and inexperienced personnel (12.3%). The trend of medication error in Malaysia showed a significant increase from January 2016 to April 2021 (APC of 2.2%) but decreased

afterward (APC of -1.1%). The significant adjusted associated factors of medication errors were inexperienced personnel (Adj. IRR=1.02; 95% CI=1.01, 1.02), inadequate knowledge (Adj. IRR=1.03; 95% CI=1.02, 1.03), distraction (Adj. IRR=1.02; 95% CI=1.02, 1.03), sound alike medication (Adj. IRR=0.98; 95% CI=0.98, 0.99), heavy workload (Adj. IRR=1.02; 95% CI=1.02, 1.03), peak hour (Adj. IRR=1.02; 95% CI=1.01, 1.02), failure to adhere to work procedure (Adj. IRR=1.06; 95% CI=1.05, 1.06), patient information or record is unavailable or inaccurate (Adj. IRR=1.07; 95% CI=1.07, 1.08), incorrect computer entry (Adj. IRR=1.02; 95% CI=1.01, 1.02), other factors (Adj. IRR=1.03; 95% CI=1.02, 1.03), location of events in the emergency department (Adj. IRR=1.05; 95% CI=1.04, 1.05), in pharmacy (Adj. IRR=0.95; 95% CI=0.94, 0.95), in ward (Adj. IRR=1.01; 95% CI=1.01, 1.01), and in others (Adj. IRR=1.04; 95% CI=1.01, 1.06). **Conclusion:** The study revealed an overall increase in reported medication errors, with multiple contributing factors. Interventions targeting training for inexperienced personnel, minimizing distractions, and addressing workload during peak hours could enhance medication safety in Malaysia.

CHAPTER 1

INTRODUCTION

1.1 Medication Errors

Medications are integral to healthcare, serving to prevent, diagnose, treat, or alleviate symptoms of various medical conditions (Mistry et al., 2023). Despite their benefits, improper use can lead to severe health consequences, including prolonged recovery, adverse effects, permanent disability, or even death (Venkatesan, 2022). Advances in medical technology have introduced complex medication regimens, increasing the risk of medication errors (Atkinson A.J. et al., 2007).

Medication errors are defined as preventable events that may lead to inappropriate medication use or harm to a patient during prescribing, transcribing, dispensing, administration, or monitoring (Assiri et al., 2018). These errors can result in no harm, temporary harm, permanent harm, or even death (Elshayib et al., 2021; Thomas Rodziewicz et al., 2024; Zirpe et al., 2020).

1.2 Burden of Medication Errors

Medication errors are a leading cause of preventable harm worldwide, with an estimated 7,000 to 9,000 deaths annually in the United States alone (Liam Donaldson et al., 2020; Tariq et al., 2023). In Malaysia, the Medication Error Reporting System (MERS) received 375,197 reports from 2009 to 2022, of which 2,092 cases resulted in patient harm (Kamaruddin F., 2023). These errors impose a significant financial burden, costing over $40 billion annually worldwide (Tariq et al., 2023). This figure

does not include additional economic impacts such as lost wages, decreased productivity, or legal and administrative cost.

Furthermore, medication errors are a leading cause of preventable harm in healthcare settings worldwide (Dhingra-Kumar et al., 2023). The incidence and frequency of medication errors differ significantly across the globe, complicating efforts to fully understand the scope of the issue. Additionally, the absence of a standardized approach to defining and classifying relevant terminology makes it difficult to compare medication errors internationally (Isaacs et al., 2021).

Moreover, a study by The Patient Safety Authority in Pennsylvania, which collected 2.2 million safety reports between 2004 and 2014, found that medication errors were the second most frequent type of incident (Silva & Krishnamurthy, 2016). Despite these figures, data on medication errors in developing countries, including ASEAN nations, remain limited (Salmasi et al., 2015)

1.3 Rationale of the study

Although extensively studied in high-income countries, medication errors remain underexplored in middle- and low-income settings like Malaysia (Abbasi et al., 2022; Basil et al., 2019). Most local studies rely on basic descriptive statistics or single-center data, limiting their generalizability (Mamat et al., 2021). Previous research using Malaysia's national database was conducted before the establishment of the online Medication Error Reporting System (Samsiah et al., 2016).

Furthermore, no studies have explored trends in medication errors or applied advanced statistical methods to identify the associated factors. This study leverages the MERS database to address these gaps, offering a more comprehensive understanding of medication errors in Malaysia.

This study also responds to WHO's call to improve patient safety and reduce the financial burden associated with medication errors. By identifying significant trends and contributing factors, this research can guide targeted interventions to enhance medication safety, optimize resource allocation, and ultimately reduce preventable harm in Malaysian healthcare settings.

1.4 Research Question(s)

1. How has the trend of medication errors reported to MERS in Malaysia evolved from 2016 to 2023, and are there significant points of change over time?
2. Are there any relationships between staff-related, medication-related, task/technology-related, work/environment-related factors, and other factors (time and location of events) with the number of medication errors reported in Malaysia?

1.5 Research Objective(s)

1.5.1 General Objective

To analyze the trend and identify factors associated with the number of medication errors reported in Malaysia from 2016 to 2023, using data from the Medication Error Reporting System (MERS).

1.5.2 Specific Objectives

1. To evaluate the trend of medication errors reported in Malaysia from 2016 to 2023 using joinpoint regression analysis.
2. To identify the factors associated with the number of medication errors in Malaysia using Poisson regression analysis.

1.6 Research Hypothesis

1. There is a significant change in the trend of medication errors reported in Malaysia from 2016 to 2023.
2. The number of medication errors is associated with staff-related factors, medication-related factors, task/ technology-related factors, work/ environment-related factors, and time and location of events.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview of Medication Errors

2.1.1 Definition of Medication Errors

Medication errors have been defined in various ways, but they generally refer to preventable events that may cause inappropriate medication use or harm to patients. The National Coordinating Council on Medication Error Reporting and Prevention (NCCMERP) 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 health care professional, patient, or consumer". Similarly, the World Health Organization (WHO) describes medication errors as failures in the treatment process that have the potential to cause harm, where it highlights the broader scope and emphasizing both actual and potential harm. In addition, the European Medicines Agency (EMA) defines medication errors as unintended failures in the drug treatment process that can lead to harm. Furthermore, the Institute for Safe Medication Practices (ISMP) defines medication errors as preventable events that occur at any stage of medication use, including prescribing, dispensing, and administration, and are primarily caused by human errors related to drug distribution, drug names, labelling, computer program design, and drug delivery design.

Medication errors can arise from various factors, including professional practice, healthcare products, and procedure or systemic issues (Juneja & Mishra, 2022). These errors may involve omission, where a necessary medication is either not administered or administered later than required; substitution, where wrong medication is given in

place of the one prescribed; repetition, involving the duplication or extra doses of medication beyond the prescribed amount; wrong dose, where incorrect medication concentrations, amounts, or rates; and wrong route, such as oral, intravenous, subcutaneous, intramuscular, or dermal (C. Gariel et al., 2018).

2.1.2 Classification of Medication Errors

The classification of medication errors in the Malaysia Medication Error Reporting System (MERS) is determined by the outcome of the error. According to the MERS User Manual 2017 from the Ministry of Health, errors are divided into four major categories, which are No Error, Error but No Harm, Error Caused Harm, and Error Caused Death. It was further divided into nine sub-categories, ranging from Category A to I, were implemented based on the National Coordinating Council for Medication Error Reporting and Prevention Error Category Index (NCCMERP) (Rejane et al., 2013). This is also known as the Medication Error Index (Ferner & Aronson, 2006). These categories are illustrated in the figure below:

Table 2.1 Categories of Medication Errors based on MERS

NO ERROR	
Category A	Potential error, circumstances or events that have the potential to cause incident.
ERROR, NO HARM	
Category B	An error occurred but the error did not reach the patient.

Category C	An error occurred that reached the patient but did not cause patient harm.
Category D	An error occurred that reached the patient and required monitoring to confirm that it resulted in no harm to the patient and/ or required intervention to preclude harm.
ERROR, HARM	
Category E	An error occurred that may have contributed to or resulted in temporary harm to the patient and required intervention.
Category F	An error occurred that may have contributed to or resulted in temporary harm to the patient and required initial or prolonged hospitalization.
Category G	An error occurred that may have contributed to or resulted in permanent patient harm.
Category H	An error occurred that required intervention necessary to sustain life.
ERROR, DEATH	
Category I	An error occurred that may contribute to or resulted in the patient's death.

2.1.3 Types of Medication Errors

Various studies or institutions categorize types of medication errors distinctly due to differences in their primary focus and objectives. Some studies categorize it based on the process of the error, such as prescribing, transcribing, filling, dispensing, administration, monitoring, compliance, and omission error (Dorothy et al., 2021; Salmasi et al., 2015; Tariq et al., 2023).

Prescribing error happens when writing a drug order or making a therapeutic choice that deviates away from standard and correct practice. Transcribing errors occur in the next step after prescribing, which is interpreting, verifying, and transferring medication orders (Van Doormaal et al., 2009). Dispensing errors refer to any deviations from a written prescription occurring during the dispensing process of selecting and assembling medication or issue of the dispensed products to patients (Rostami-Hochaghan P, 2018). Administration error occurs when a patient does not receive the exact medication in terms of type, dose, frequency, or route of administration that was recommended and it happen during the final stage of the drug use process (Assunção-Costa et al., 2022).

Others may classify medication errors based on a taxonomy of specific errors, such as wrong drugs, wrong patients, wrong technique, wrong durations, wrong time, wrong frequencies, wrong routes of administration, drug interactions, intravenous incompatibilities, overdose and others (Aldayyen et al., 2023; Bante et al., 2023; Cassidy et al., 2011; Latif et al., 2013; Manias et al., 2019; Tabatabaee et al., 2022).

Additionally, certain studies compare medication errors based on the outcome measures of the error, distinguishing between near misses (errors that did not reach the patient) and actual errors (medication not taken by the patient, or medication taken by the patient) (Samsiah et al., 2016). These types of medication errors reported may overlap or differ between studies or institutions, reflecting the diverse perspectives and objectives of the researchers involved.

2.1.4 Relationship between ADEs, ADRs and MEs

Adverse Drug Events (ADEs), Adverse Drug Reactions (ADRs), and Medication Errors (MEs) are all types of medication misadventures, which refer to any iatrogenic hazard or incident associated with medications (Nebeker et al., 2004). Because ADEs, ADRs, and MEs are related notions that can overlap, they are frequently used interchangeably. The term is important in the field of pharmacovigilance even though the distinctions between them can be complex and may differ across organizations and publications.

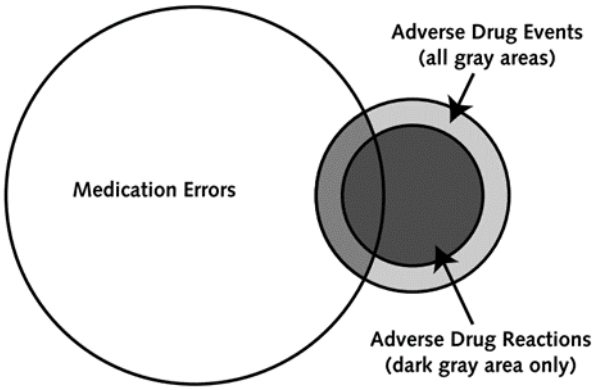

Figure 2.1 The relationship between ADEs, ADRs and MEs. A small proportion of MEs represent ADEs and ADRs, while all ADRs are under ADEs (Nebeker et al., 2004).

ADEs, or common general term of an adverse event, occur when a patient is harmed due to use or exposure to a medication. It includes harm caused by the medication itself, such as an overdose or an allergic reaction, as well as harm from the use of the medication, such as dose reductions or discontinuations of drug therapy. However, ADEs do not always signify a mistake or poor care. ADEs will refer to all ADRs,

including allergic or idiosyncratic reactions and MEs that harm the patient, with most ADEs not resulting from MEs (Nebeker et al., 2004).

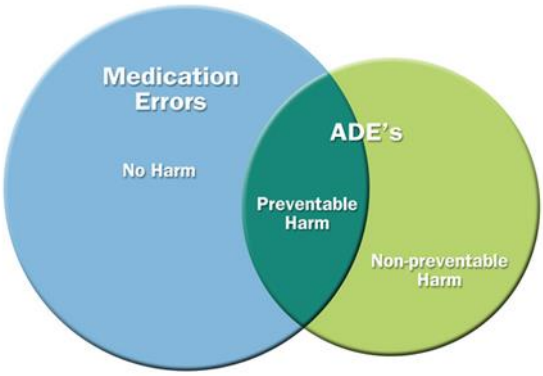

Figure 2.2 The relationship between MEs and ADEs with No Harm, Preventable and Non-preventable Harm (Shawn C. Becker, 2015).

Unlike MEs, which are preventable events, ADEs can be categorized into preventable and non-preventable ADEs. For example, preventable ADEs when an opioid-naive patient with a history of sleep apnea was administered IV Hydromorphone due to current illness resulting in respiratory distress, while non-preventable ADEs when a patient with no history of drug allergy was experiencing facial swelling after was administered with Augmentin for current infection problem (Shawn C. Becker, 2015).

ADR, or generally known side effect, is an unintended, harmful reaction to a drug that occurs at normal usage and correct therapeutic doses that was appropriately prescribed to patients (Dedefo et al., 2016). WHO defines an ADR as “any response that is noxious, unintended, or undesired, which occurs at doses normally used in humans for prophylaxis, diagnosis, therapy of disease, or modification of physiological function (Tariq et al., 2023).

ADRs are expected to have negative outcomes that naturally arise from a drug's pharmacological action and are not always preventable. In contrast, MEs are preventable (Tariq et al., 2023). ADR is categorized into type A and B, where type A is typical, predictable, and dose-dependent. In contrast, type B is usually unpredictable, dose-independent and mediated by an immune response or referred to as allergy (Böhm et al., 2018). ADRs are also equivalent to non-preventable ADEs terminology suggested by NCC-MERP (Shawn C. Becker, 2015). The other term commonly used is a side effect, which is a subset of ADR that represents a predicted and well-known effect of a drug that is not the intended therapeutic outcome, where it is usually listed in the medication's product information.

However, the concept of MEs is such that even though it also causes patient harm, it is not entirely due to the use or exposure to the medication itself. Still instead, it involves the medication use process, such as prescribing, transcribing, dispensing, administering, adherence, or monitoring a drug (Assiri et al., 2018). It falls under the category of preventable ADEs, and it is entirely under the control of the healthcare system (Atkinson A.J. et al., 2007).

2.2 Impact of Medication Errors

2.2.1 Patients

Medication errors can lead to both immediate physical and psychological consequences for patients (Isaacs et al., 2021). These consequences may range from the exacerbation of the patient's existing condition, increased physical pain or suffering, onset of disability or, in severe cases, fatalities (Bates & Slight, 2014; Neha Vemuri et al., 2022; Wittich et al., 2014).

The impact on patients may go beyond physical health, where it can erode the patient's trust towards healthcare providers (Papazides & Capstone, 2014; Tariq et al., 2023; Wittich et al., 2014). Patients may experience anxiety and uncertainty about their care, leading to increased stress and a sense of vulnerability. Furthermore, the emotional distress resulting from medication errors, including feelings of anger, frustration, anxiety, depression, and helplessness, can contribute to a significant decline in mental well-being.

Medication errors can also have long-term social and economic impacts (Ottosen et al., 2021). The financial burden from prolonged hospital stays, additional medical treatments, challenges returning to work or resuming their daily life, and potential loss of income due to extended recovery periods can significantly affect the patient (Chiewchantanakit et al., 2020; Tariq et al., 2023). Additionally, medication errors can create lasting fear and anxiety about taking medications, which may lead to medication non-adherence and reluctance to seek future medical care.

In addition to affecting the patient, medication errors can have broader effects on families and caregivers. They often experience significant emotional distress, which can intensify if the error results in permanent injury or, in the worst cases death. This not only compounds the emotional burden but also places a heavy financial strain on families, particularly when the patient is the primary source of income.

2.2.2 Healthcare System

Medication errors pose significant challenges to healthcare systems, impacting finances, resource allocation, and professional well-being. Errors increase costs due to prolonged hospital stays, additional treatments, and legal liabilities. In the United States, these costs exceed $40 billion annually, affecting more than 7 million individuals (Tariq et al., 2023). Similar financial strains are seen in healthcare systems worldwide, hindering effective resource allocation and burdening government budgets (Jalloh, 2023).

Legal and regulatory repercussions further exacerbate the problem. Healthcare providers may face lawsuits, financial penalties, and reputational damage, which can erode public trust and reduce organizational credibility (Wittich et al., 2014). The need for extensive investigations and retraining adds to the workload for staff, diverting resources from other critical tasks (Al Mardawi & Rajendram, 2021).

For healthcare professionals, the emotional toll of medication errors can be severe, leading to guilt, anxiety, and even burnout or PTSD (Mahat et al., 2022; Neha Vemuri et al., 2022; Robertson & Long, 2018). These feelings may affect their ability to

provide care effectively, contributing to job dissatisfaction and increased turnover (Mahat et al., 2022; Papazides & Capstone, 2014). Addressing these emotional burdens through supportive work environments and open communication is essential for maintaining staff well-being.

At an organizational level, medication errors can disrupt teamwork and collaboration, creating a negative work environment. Efforts to reduce errors, such as root cause analysis, enhanced protocols, and ongoing staff education, are essential to fostering a culture of safety and accountability. Healthcare systems must prioritize these initiatives to minimize harm and enhance patient outcomes.

2.3 Medication Errors and Pharmacovigilance System

2.3.1 History and development

The 1999 *To Err is Human* report by the Institute of Medicine (IOM) was a turning point in addressing the global issue of medication errors, emphasizing the need for robust reporting systems to enhance patient safety (Bates & Singh, 2018; Pellegrini, 2020). Key recommendations from the report included the establishment of systems to collect and analyze data on medication errors, fostering transparency and accountability (Kohn et al., 2000).

Inspired by this, the Danish Patient Safety Database (DPSD) was launched in 2004, followed by England and Wales' National Reporting and Learning System (NRLS) in the same year (Vittal Katikireddi, 2004). These systems mandated healthcare workers to report safety incidents, initially in public hospitals and later in community care services, pharmacies, and general practices. The DPSD now records approximately 200,000 incidents annually, with medication-related events being the largest category (Tchijevitch et al., 2023).

In 2017, WHO launched the Medication Without Harm initiative to reduce serious preventable injuries caused by medication errors by 50% within five years (Abbasi et al., 2022; Donaldson et al., 2017; Venkatesan, 2022). This initiative highlighted the global need for improved pharmacovigilance systems, focusing on patient safety in all healthcare settings.

2.3.2 Pharmacovigilance in Malaysia

Recognizing the importance of error reporting in improving patient safety, Malaysia established the Medication Error Reporting System (MERS) in 2009. This initiative, managed by the Pharmacy Practice and Development Division of the Ministry of Health Malaysia, was introduced six years after the Danish Patient Safety Database (Muhammad et al., 2019). Initially a basic reporting system, MERS was upgraded to a web-based platform to enhance accessibility and facilitate real-time reporting.

The first edition of the Guideline on Medication Error Reporting was published in July 2009, providing a framework for healthcare professionals to report incidents across public and private healthcare settings. Regular updates to the guideline, including the 2021 version currently in use, reflect the system's commitment to continuous improvement (Muhammad et al., 2019).

While MERS has enhanced error reporting and transparency, challenges such as underreporting, limited awareness, and resource constraints remain. Addressing these barriers through education, anonymous reporting mechanisms, and better resource allocation could further strengthen its role in improving patient safety in Malaysia.

2.4 Trend of medication error

Medication error trends vary widely across regions and time periods, influenced by factors such as reporting systems, healthcare infrastructure, and cultural attitudes toward patient safety. However, studies employing advanced statistical methods like Joinpoint regression to investigate these trends remain limited.

2.4.1 Global Trends

In U.S. hospitals, a study observed a 2.57-fold increase in deaths due to medication errors, rising from 2,876 in 1983 to 7,391 in 1993, outpacing the 1.39-fold increase in prescription volume during the same period (Phillips et al., 1998). Similarly, in England and Wales, incidents of medication administration errors rose significantly, from 29,455 in 2007 to 72,390 in 2016 (Härkänen et al., 2021). Fatalities in the UK also showed an upward trend between 1990 and 2000 (Andrew Foster, 2001; Aronson, 2009).

In contrast, a five-year retrospective study in a Jordanian teaching hospital reported a declining trend, with medication errors decreasing from 988 cases (31.2%) in 2009 to 454 cases (14.3%) in 2013, potentially reflecting effective prevention measures (Al-Faouri et al., 2014).

2.4.2 Asian Trends

Studies in Asia also demonstrate variability. In Australia, a gradual increase in medication errors was reported between 2014 and 2018 (Isaacs et al., 2021). Indonesia saw a slight increase in dispensing-stage errors from 2016 to 2017 (Hasna et al., 2020).

Meanwhile, South Korea experienced fluctuations, with near miss errors peaking in 2015 before stabilizing by 2018 (Yoon & Sohng, 2021).

2.4.3 Trends in Malaysia

In Malaysia, medication error trends have consistently risen, reflecting improved reporting systems and growing awareness. According to the Malaysian Medication Error Reporting System (MERS), reported cases increased over 24-fold from 2,572 in 2009 to 63,781 in 2022. Notable spikes occurred between 2013 and 2014 (from 8,422 to 16,897 cases) and between 2017 and 2018 (from 26,056 to 44,211 cases). The sharp rise may be attributed to the 2013 upgrade of MERS into a web-based platform, facilitating greater ease and accuracy in reporting.

While these trends highlight the growing recognition of medication errors in Malaysia, further analysis is needed to understand underlying causes, such as systemic issues in healthcare delivery or increased workload during specific periods. These findings underscore the importance of robust reporting systems and continuous education for healthcare professionals to mitigate medication errors and improve patient safety.

2.5 Associated Factors of Medication Error

2.5.1 Overview of Malaysia's Public Healthcare Facilities

In Malaysia, public healthcare is mainly provided by government hospitals and clinics, which serve most of the population with various medical services. These hospitals are mainly under the Ministry of Health (MOH), but some are managed by other ministries, like the Ministry of Education (MOE) and the Ministry of Defence (MINDEF) (Jabatan Digital Negara, 2024). Even though they are run by different ministries, all these hospitals are considered government hospitals, playing a key role in the country's healthcare system ("Health Facts Malaysia," 2023).

The Ministry of Education (MOE) oversees several university medical centers, such as Pusat Perubatan Universiti Malaya (PPUM) and Pusat Perubatan Universiti Kebangsaan Malaysia (PPUKM). Similarly, the Ministry of Defence (MINDEF) manages military hospitals, including Hospital Angkatan Tentera Pangkalan TLDM Lumut and Hospital Angkatan Tentera Tuanku Mizan.

Based on Table 3.2 below, it shows a gradual reduction in the total number of MOH healthcare facilities in Malaysia, from 3,364 in 2016 to 3,186 in 2022, with most of this reduction attributed to a decline in the number of health clinics. The decrease in facilities could be due to cost-cutting measures, consolidation of healthcare services to optimize resource allocation, or restructuring in response to changing healthcare priorities. Despite this decline, the number of MOH hospitals, MOH Special Medical Institutions and Non-MOH facilities remained relatively stable with slight increase from 2016 to 2022.

Based on figure 3.3 below, the number of hospital beds increased from 37,293 in 2016 to 39,581 in 2022, indicating a continued expansion in hospital capacity to accommodate growing patient numbers, particularly in inpatient care. The changes in healthcare facilities could have given implications for medication errors. With fewer health clinics, and potential strain on existing hospitals and specialized institutions, healthcare professionals may experience increased workloads, higher patient volumes.

Table 2.2 Annual Summary for Number of Public Healthcare Facilities in Malaysia from 2016 until 2022

Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
MOH Facilities[a]	3,364	3,367	3,368	3,315	3,293	3,207	3,186
Hospitals	135	135	135	135	135	135	137
Special Medical Institute[b]	9	9	9	9	11	11	11
Health Clinics[c]	3,220	3,223	3,224	3,171	3,147	3,061	3,038
Non-MOH Facilities[d]	9	10	10	10	10	12	12

[a] Total number of all public healthcare facilities under Ministry of Health Malaysia

[b] Refers to Rehabilitation Hospital, National Leprosy Control Centre, Institute of Respiratory Medicine, National Cancer Institute, Sarawak Heart Centre, Pyschiatric Institutions, and Women & Children Hospital

[c] Refers to Health Clinics, Rural Clinics (Klinik Desa), and Community Clinics

[d] Refers to Military Hospital (Under Ministry of Defence Malaysia) and University Hospital (Under Ministry of Education)

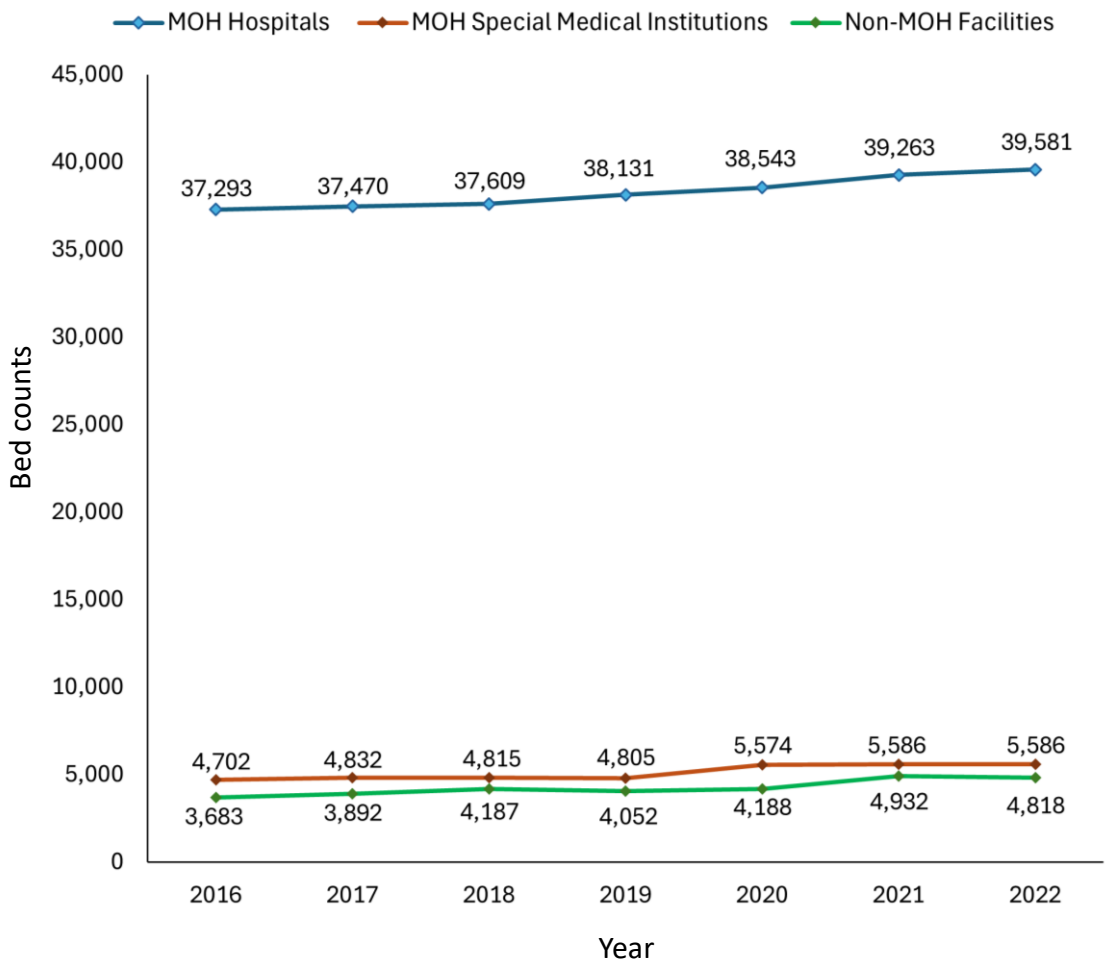

Figure 2.3 Annual Summary of Official Bed Counts for Public Healthcare Facilities in Malaysia from 2016 until 2022 ("Health Facts Malaysia," 2023)

2.5.2 Staff Related Factors

Medication errors can occur at multiple stages of the medication process, involving various healthcare personnel (Brunetti & Suh, 2012; Tariq et al., 2023). Generally, physicians are tasked with prescribing and administration of medications, nurses with preparation and administration, while pharmacists are responsible for transcription, preparation, and dispensing. Several studies have identified staff-related factors as significant contributors to medication errors, such as inexperienced personnel, inadequate knowledge, and distractions.

Inexperience among healthcare personnel is a critical issue, with errors more likely among newly graduated professionals or those with less than six years of experience (Aldayyen et al., 2023; Basil et al., 2019). For example, a study in Saudi Arabia found that 57.9% of medication errors were linked to inexperienced personnel, particularly newly graduated resident physicians (Aldayyen et al., 2023). Another study suggest that deficiencies in skills are contributors to medication errors, with a noticeable decrease in medication errors as nurses gain more experience (Westbrook et al., 2011).

Inadequate knowledge is another critical factor, particularly among prescribers. Studies have identified prescribing errors as the most common type of medication error, often caused by insufficient training (Elshayib et al., 2021). Additionally, insufficient training of prescribers has been highlighted as a major cause of prescription errors (Chang et al., 2018). Moreover, despite of adequate staffing levels during shifts, a high incidence of medication errors may indicate that a lack of knowledge and skills among the personnel (Basil et al., 2019). In Australia, higher levels of nursing knowledge were associated with fewer errors, emphasizing the importance of training and education (Isaacs et al., 2021; McKeon et al., 2006).

Additionally, distractions during the medication process, such as interruptions while administering drugs, significantly increase the likelihood of errors (Manias et al., 2021). Addressing these issues requires targeted interventions, such as structured training programs, minimizing interruptions, and fostering continuous professional development.

2.5.3 Medication Related Factors

Medication characteristics, such as look-alike and sound-alike (LASA) medications, significantly contribute to errors. In a Malaysian study, LASA medications were a secondary factor in dispensing errors, although distractions during filling were the primary cause (Rajah et al., 2019). In Iran, 72% of nurses reported at least one LASA-related error in six months, highlighting the prevalence of this issue (Mosakazemi et al., 2019). The study identified confusion between look-alike and sound-alike (LASA) medications across multiple process stages as a significant systemic cause of medication errors (Kuitunen et al., 2020).

Additionally, packaging design also plays a role, with similar-looking or poorly labelled packaging increasing the risk of errors (Vallerand & Sanoski, 2019). Interventions such as clear labelling, distinct packaging, and staff training to recognize LASA risks can reduce these errors. Implementing electronic alerts for LASA medications in prescribing systems could also improve safety.

2.5.4 Task and Technology Related Factors

Several studies have identified task and technology-related factors as significant contributors to medication errors. In Saudi Arabia, inadequacy of work procedures policy accounted for 48.3% of medication errors, emphasizing the critical role of existence and following established guidelines (Aldayyen et al., 2023). Meanwhile failure to follow established procedures is a leading cause of medication errors. In Australia, 82.4% of errors were attributed to procedural non-compliance, while double-checking medications reduced error rates significantly (Manias et al., 2021).

The use of non-standard or ambiguous abbreviations in prescriptions has been shown to contribute to errors, as evidenced by a study conducted in Brazil found that the use of non-standard abbreviations in handwritten prescriptions significantly contribute to medication errors (Rosa et al., 2009). Additionally, a study conducted in Sri Lanka highlights that the use of abbreviations is frequently prone to misinterpretation, which exacerbates the risk of confusion and can lead to errors in medication dispensing (Samaranayake et al., 2012).

Additionally, illegible prescriptions further exacerbate the problem. Studies in Sri Lanka and South Africa found that poorly written prescriptions and inadequate digital entry systems led to confusion and potentially dangerous errors (Brits et al., 2017; Samaranayake et al., 2012).

Moreover, unavailable or inaccurate patient information can significantly impact patient safety by leading to inappropriate dosages or treatments, particularly in vulnerable populations or when medications require weight-based dosing (Brunetti & Suh, 2012).

Incorrect labelling on dispensing envelopes or containers contributes to medication errors, as evidenced by a study conducted at a tertiary care hospital where incorrect labelling accounted for 15.38% of dispensing errors (Chand et al., 2022).