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# A RETROSPECTIVE ANALYSIS OF MEDICATION ERRORS AT A TERTIARY HOSPITAL IN A NORTHERN STATE OF MALAYSIA

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## ABSTRACT

*Medication errors (MEs) have been recognised as a global issue. The occurrence of MEs can lead to serious clinical outcomes and represents a significant concern for healthcare providers and policymakers. This study aims to analyse the characteristics and pattern of MEs reported at Hospital Raja Permaisuri Bainun (HRPB), Ipoh in 2019. This study was conducted by reviewing ME reports at the HRPB from 1 January 2019 to 31 December 2019. A total of 1,066 ME reports were received by the* Drug Information Centre *(DIC) of the HRPB in 2019. However, only 1,045 reports that fulfilled the inclusion and exclusion criteria were reviewed. From these reports, 97.5% of errors were classified as near-misses. The actual error rate is only 2.5%. More than four-fifth of the overall reports originated from the wards (91.1%). The mean age of the patients exposed to MEs was 47.64 ± 24.32 years. Collectively, the geriatrics patients were the largest identified group that encountered MEs (n = 387, 37.1%). The prescribing stage accounted (97.4%) for almost all the MEs. Cases of wrong dose (52.3%) contributed to more than half of the overall error. About 99.4% of the errors had no harmful effect on the patient's health conditions. The cardiovascular system (25.0%) was the most common drug class involved in ME. Staff factor was believed to be the principal contributing factors that lead to MEs. Majority of the MEs were detected and reported by the pharmacist. Effective implementation of proper guidelines and existing preventive strategies would help in reducing and eliminating MEs, thus improving clinical practices and ensure patients' safety.*

***Keywords*:** Medication errors, Near misses, Actual errors, Drugs, Outcomes

## INTRODUCTION

Medication errors (MEs) are well recognised as problems related to medication use. With substantial and increasing medication utilisation, especially with complex medical needs, there is a growing risk of harm due to the occurrence of MEs (World Health Organization

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2018). Healthcare facilities around the world prioritise patient safety and it is a fundamental step in providing high-quality care (Farzi *et al*. 2018).

MEs prevalence and incidence rates vary around the world. In Saudi Arabia, Ali *et al*. (2017) found 13,677 errors out of 912,00 prescriptions, accounting for an incidence rate of 1.5%. In another study in Mexico, 58% of prescriptions were found to have errors (Zavaleta-Bustos 2008). The accuracy of MEs occurrence rate is very difficult to determine as MEs reporting is voluntary. In Malaysia, almost all reports came from health institutions under the Ministry of Health (MOH) with only 2% from private and teaching hospitals as found by Samsiah *et al*. (2016). The number of prescriptions received from the MOH hospitals within 4 years is approximately 68.6 million and 17,357 reports of MEs were received (Ministry of Health 2011; 2014). The incidence rate of ME is roughly estimated at 0.025%. Another Malaysian study that focused on geriatrics reported 403 prescriptions with MEs which translated to the prevalence of 20 cases of MEs per day (Abdullah, Ibrahim and Ibrahim 2004). The obstacle in determining the nationwide MEs incidence rate in Malaysia is due to the dichotomous public and private healthcare system, whereby the reporting rate from the private sector is very low (Samsiah *et al*. 2016).

A wide range of interventions has been undertaken to address the problem of MEs by healthcare institutions to reduce their incidence. Interventions are usually targeted and mainly focussed on systems' approaches including the implementation of error reporting system (Abuelsoud 2018), usage of technology in the healthcare system and application of error detection tools, as well as the establishment of guidelines, policies and procedures in managing MEs (Nguyen *et al*. 2015).

The Medication Error Reporting System (MERS) (Pharmaceutical Services Programme Ministry of Health Malaysia 2019), a method used to track MEs consistently and systemically was developed and introduced in the MOH in 2009. It is a voluntary reporting system for all healthcare professionals in the public and private healthcare facilities to report MEs. Samsiah *et al*. (2016) undertook a 4-year (2009–2012) retrospective review of 17,357 MEs reported through MERS. The findings showed that MEs classified as near misses were 86.3% of all errors and the majority (98.1%) did not harm patients. Of the 1.9% (323) of errors that caused harm, 319 experienced temporary harm while four were fatal. More than 75% of the errors were prescribing errors while actual errors accounted for approximately 14%. Amongst all the healthcare providers, pharmacists detected the most errors. Pharmacists being the health care professional that screen all prescriptions before dispensing to patients and going through medication charts before supplying medicines for inpatients are in the best position to detect and discover any error.

Since the establishment of MERS in Malaysia, most analyses of MEs have been taken on a small scale at the department level (Shitu *et al*. 2020) and on healthcare personnel (Dyab *et al*. 2018) at different hospitals in the country. However, there is a lack of recent study, which specifically aims to analyse the characteristics of the MEs reported to MERS. The latest analysis on MEs reported nationwide between 2009 and 2012 was dated back in 2016 (Samsiah *et al*.). The characteristics of MEs in a tertiary referral hospital may be similar or different from what has been studied before. Therefore, this study aimed to analyse the characteristics of MEs reported at the Hospital Raja Permaisuri Bainun (HRPB) in Ipoh, Perak, in 2019.

## METHOD

### Setting and Sample

A retrospective analysis of ME reports submitted through MERS over 1 year, from January to December 2019 was undertaken. The data from the reports were collected at the Drug Information Centre (DIC) of the HRPB. The HRPB is a tertiary hospital in Ipoh, the capital city of Perak, which is a state in the northern region of West Malaysia.

### Data Collection

All reports submitted through MERS and had no missing data were included in the study. Reports with missing data were excluded. The reports were reviewed and data obtained were transferred into an electronic data collection form which was developed from Microsoft Excel. Data that were collected and transferred include patient demography, types of errors, drug implicated for the error, location of the error, stage of occurrence of the error, possible cause of the error, the healthcare provider who detected the error and the outcomes of error.

The types of ME and patient's clinical outcome attributed to the error were characterised based on the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) taxonomy of errors (NCC MERP Taxonomy of Errors 1 n.d). Any new type of error was added to the list of errors during the data entry process.

All drugs implicated in the errors were reported in generic names but if they were reported by the product names, their non-proprietary names were searched from the National Pharmaceutical Regulatory Agency (NPRA) Product Search database. The drugs were categorised according to the WHO Anatomical Therapeutic Classification (WHOCC 2019).

The main investigator (MF) collected the data from the DIC of the HRPB in February 2020. Any incomplete or missing data was clarified with the pharmacist-in-charge of the ME reports. The completed data collection form was then checked by the other main investigator (NHO). Data entered was scanned for any irregularity and checked against the code given for each parameter. The data was analysed using SPSS version 23.0. Descriptive analysis was carried out for categorical data and reported as frequency and percentage, while continuous data were analysed for mean and standard deviation.

### Ethical Approval

This study received approval from the Medical Research Ethics Committee (MREC) through the National Medical Research Register (NMRR) under the approval number NMRR-19-3674-52372 (IIR).

## RESULTS

A total of 1,066 ME reports were received by the DIC of the HRPB for 2019. Of these, 21 reports with missing data were excluded. The missing data were patients' age ($n$ = 7), location of the event ($n$ = 1) and drugs involved in the error ($n$ = 13). The final number of ME reports included for analysis was 1,045.

**Patient Demography**

The rate of occurrence of MEs was found to differ between age groups. Patients within the age group of 61 years old–70 years old have the highest percentage of MEs at 18.3%, followed by those in the 51 years old–60 years old at 14.8% and 71 years old–80 years old at 13.5%. Collectively, for those above 60 years old, the incidence of MEs was 37.1%. The incidence of MEs was 12.8% among paediatric patients. An in-depth analysis of actual errors showed that 50% of them occurred in paediatric patients. For this study, patients aged 0 year old–15 years old are classified as paediatric patients. In general, the mean age of patients who experienced MEs was 47.64 + 24.32 years old. The youngest patient was 4 days old while the oldest was 97 years old. Table 1 shows the MEs distribution by age. ME occurrence by gender is shown in Table 2, which showed that its occurrence is slightly higher in males compared to females.

**Table 1:** Medication error by age.

| Age group (years old) | Frequency | Percentage |
|---|---|---|
| 0–5 | 90 | 8.6 |
| 6–10 | 25 | 2.4 |
| 11–15 | 19 | 1.8 |
| 16–20 | 31 | 3.0 |
| 21–30 | 116 | 11.1 |
| 31–40 | 115 | 11.0 |
| 41–50 | 107 | 10.2 |
| 51–60 | 155 | 14.8 |
| 61–70 | 191 | 18.3 |
| 71–80 | 141 | 13.5 |
| 81 and above | 55 | 5.3 |
| Total | 1,045 | 100 |

**Table 2:** Medication error by gender.

| Gender | Frequency | Percentage |
|---|---|---|
| Male | 571 | 54.6 |
| Female | 474 | 45.4 |
| Total | 1,045 | 100 |

**Classification, Location and Management of MEs**

The actual error rate was found to be only 2.5% in which 26 of the 1,045 reports had reported the occurrence of errors that reach patients. The other remaining 97.5% of the reports were classified as near misses. This meant that errors committed by the healthcare providers were intercepted before they reach the patients. From the 26 actual errors that occurred, 84.6% (22 out of 26) of the patients took the medications.

More than four-fifth of the errors reported (91.1%) originated from the wards (Table 3). Meanwhile, 7.4% and 1.4% of the reported cases happened at the clinics and pharmacies, respectively. The Accident and Emergency Department (A&E) only reported one case of MEs.

**Table 3:** Location of error.

| Location MEs occurred | Frequency | Percentage |
|---|---|---|
| Ward | 952 | 91.1 |
| Clinic | 77 | 7.4 |
| Pharmacy | 15 | 1.4 |
| A&E Department | 1 | 0.1 |
| Total | 1,045 | 100 |

*Note*: A & E = Accident and Emergency.

Most of the MEs were detected by pharmacists (*n* = 1010, 96.5%), of which the pharmacists on training, also known as provisionally-registered pharmacists (PRP) detected the most errors at 61.4% (*n* = 643). A much smaller number of errors were detected and reported (*n* = 28, 2.7%) by pharmacist assistants. Medical officers (MO) detected only six errors but none were from house medical officers (HMO). Two errors were detected by the specialists and nurses, respectively. There was only one error that was detected by the patient and caregiver. Medical professionals are more likely to detect and report actual errors rather than near-miss errors.

**Stage, Type and Outcome of MEs**

The prescribing stage was found to be the stage with the highest occurrence of MEs. This is shown in Table 4, whereby 97.4% of the errors occurred during this stage. This was followed by the administration (1.1%), dispensing (0.8%) and filling (0.6%) stage. Only one error happened during the labelling stage. An analysis of actual errors revealed that although the administration stage only contributed 1.1% of the overall errors, it contributed to the highest occurrence of actual errors with 12 out of 26 errors (46.2%). The prescribing stage came second with seven errors (26.9%). The other remaining actual errors were found at the dispensing (23.1%) and filling (3.8%) stage.

**Table 4:** Stages of error.

| Stage of ME | Overall reports | | Actual error | |
|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage |
| Prescribing | 1,019 | 97.4 | 7 | 26.9 |
| Administration | 12 | 1.1 | 12 | 46.2 |
| Dispensing | 8 | 0.8 | 6 | 23.1 |
| Filling | 6 | 0.6 | 1 | 3.8 |
| Labelling | 1 | 0.1 | 0 | 0.0 |

*(continued on next page)*

**Table 4:** (*continued*)

| Stage of ME | Overall reports | | Actual error | |
|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage |
| Data Entry System | 0 | 0.0 | 0 | 0.0 |
| Total | 1,046* | 100 | 26 | |

*Note*: *There was one case with an error happening at two stages.

Error from wrong dose contributed to more than half of the overall error (Table 5) with incomplete prescription (*n* = 219, 20.7%) found to be the second largest identified group followed by wrong frequency (*n* = 152, 14.4%) and wrong drug (*n* = 45, 4.3%). There were another three types of errors that occurred more than 10 times out of the total errors. They were wrong dosage form (*n* = 28, 2.6%), wrong drug formulation (*n* = 20, 1.9%) and wrong duration (*n* = 17, 1.6%). Further analysis of actual error disclosed that wrong administration was the most common error type (*n* = 8, 30.8%) followed by wrong drug (*n* = 7, 26.9%), and wrong dose which contributed to 15.4% (*n* = 4) of the total actual error.

**Table 5:** Types of MEs.

| Types of MEs | Overall reports | Actual errors |
|---|---|---|
| Wrong dose | 553 (52.3%) | 4 (15.4%) |
| Incomplete prescription | 219 (20.7%) | 0 (0.0%) |
| Wrong frequency | 152 (14.4%) | 0 (0.0%) |
| Wrong drug | 45 (4.3%) | 7 (26.9%) |
| Wrong dosage form | 28 (2.6%) | 0 (0.0%) |
| Wrong drug formulation | 20 (1.9%) | 0 (0.0%) |
| Wrong duration | 17 (1.6%) | 0 (0.0%) |
| Wrong administration | 9 (0.9%) | 8 (30.8%) |
| Wrong filing | 3 (0.3%) | 0 (0.0%) |
| Wrong strength/concentration | 3 (0.3%) | 2 (7.7%) |
| Wrong time | 2 (0.2%) | 2 (7.7%) |
| Wrong patient | 2 (0.2%) | 2 (7.7%) |
| Wrong labelling | 2 (0.2%) | 1 (3.8%) |
| Dose omission | 1 (0.1%) | 0 (0.0%) |
| Wrong route | 1 (0.1%) | 0 (0.0%) |
| Total | 1,057* (100%) | 26 (100%) |

*Note*: *There were 12 cases with two different types of error.

Approximately 99.4% of the errors had no harmful effect on the patient's health condition. The majority of the errors (*n* = 1019, 97.4%) were found in Category B which is also termed as a near-miss error. For this category of error, an error has been committed but it did not reach the patient. The rest of the errors (Categories C–I) are known as actual errors (Table 6). Of the 26 actual errors that have reached patients, 77% (*n* = 20) caused

no harm to the patients. However, 6 (23.1%) of the actual errors caused temporary harm to the patients. The six actual errors that were reported to cause harm were found to be due to administration error (2 cases), wrong drug (2 cases), wrong dose (1 case) and wrong drug strength/concentration (1 case). Further analysis of actual errors disclosed that wrong administration and wrong drug contributed to 15.4% (*n* = 4) of the total actual errors that cause temporary harm that needs intervention. However, none of the errors cause any fatality. Patient clinical outcomes due to MEs are shown in Table 6.

**Table 6:** Patient clinical outcomes.

| *Clinical outcome | | Overall reports | | Actual errors | |
|---|---|---|---|---|---|
| | | Frequency | Percentage | Frequency | Percentage |
| No error | A | 0 | 0.0 | 0 | 0.0 |
| Error, no harm | B | 1,019 | 97.4 | 0 | 0.0 |
| | C | 10 | 1.0 | 10 | 38.5 |
| | D | 10 | 1.0 | 10 | 38.5 |
| Error, harm | E | 4 | 0.4 | 4 | 15.4 |
| | F | 2 | 0.2 | 2 | 7.7 |
| | G | 0 | 0.0 | 0 | 0.0 |
| | H | 0 | 0.0 | 0 | 0.0 |
| Error, death | I | 0 | 0.0 | 0 | 0.0 |
| Total | | 1,045 | 100 | 26 | 100 |

| | |
|---|---|
| A | Potential error |
| B | Actual error - did not reach the patient |
| C | Actual error - caused no harm |
| D | Additional monitoring required - caused no harm |
| E | Treatment/intervention required - caused temporary harm |
| F | Initial/prolonged hospitalisation - caused temporary harm |
| G | Caused permanent harm |
| H | Near death event |
| I | Death |

*Note*: *Category of clinical outcomes is based on the NCC NERP taxonomy.

### Medication Category

A total of 1,094 medications were found to be associated with MEs in this study. Overall, medications for the cardiovascular system (*n* = 274, 25%) anti-infective for systemic use (*n* = 268, 24.5%) and drugs for the alimentary tract and metabolism (*n* = 222, 20.3%) were the most common drugs in causing MEs. These were followed by medications for the nervous system (6.9%) and blood and blood-forming agents (5.3%). The same category of medications was also implicated in causing actual errors, whereby there were 8 (30.5%) reports for cardiovascular system agents, followed by 6 (23.1%) for nervous system agents

and 5 (19.2%) for anti-infective for systemic use. Table 7 shows the distribution of errors by class of medications. Cefuroxime, enoxaparin, gliclazide, metronidazole and ranitidine were the top five drugs that caused MEs.

**Table 7:** Class and type of drugs causing MEs.

| **Class of drug** | **Overall reports** | **Actual errors** |
|---|---|---|
| Cardiovascular system | 274 (25.0%) | 8 (30.8%) |
| Anti-infective for systemic use | 268 (24.5%) | 5 (19.2%) |
| Alimentary tract and metabolism | 222 (20.3%) | 3 (11.5%) |
| Nervous system | 75 (6.9%) | 6 (23.1%) |
| Blood and blood forming agents | 58 (5.3%) | 0 (0.0%) |
| Systemic hormonal preparation | 48 (4.4%) | 2 (7.7%) |
| Respiratory system | 39 (3.6%) | 0 (0.0%) |
| Musculoskeletal system | 35 (3.2%) | 1 (3.8%) |
| Various | 31 (2.8%) | 1 (3.8%) |
| Dermatological | 19 (1.7%) | 0 (0.0%) |
| Genito-urinary system and sex hormone | 13 (1.2%) | 0 (0.0%) |
| Antineoplastic and immunomodulating agent | 6 (0.5%) | 0 (0.0%) |
| Antiparasitic products | 4 (0.4%) | 0 (0.0%) |
| Sensory organs | 2 (0.2%) | 0 (0.0%) |
| Total | 1,094 (100%) | 26 (100%) |
| **Type of drug** | **Frequency** | **Percentage** |
| Cefuroxime | 65 | 5.9 |
| Enoxaparin | 44 | 4.0 |
| Gliclazide | 42 | 3.8 |
| Metronidazole | 28 | 2.6 |
| Ranitidine | 23 | 2.1 |

**Contributing Factors to MEs**

Staff factor was found to be the contributing factor that leads to the occurrence of a MEs. Staff factor comprised of inexperienced personnel, lack of knowledge and distraction. It was responsible for more than three-quarters (79.4%) of overall reported MEs. Task and technology, which comprised of failure to adhere to work procedure, use of abbreviations, illegible prescriptions, patient information or record is unavailable or inaccurate, wrong labelling, wrong instruction on dispensing container and incorrect computer entry, was reported as the second contributing factors (18.5%) that lead to the occurrence of MEs. Collectively, a medication-related factor only contributed 0.6% of the total errors.

## DISCUSSION

This study finds that geriatric patients are more prone to MEs. This same result was also found by Sheikh *et al*. (2017) and Abdullah *et al.* (2004). Advanced age, reduced kidney and liver functions, comorbidities, non-compliance to prescribed medicines and polypharmacy are factors that increase the likelihood of risk of MEs in older patients (Wittich, Burkle and Lanier 2016). This study also found that half of the actual errors occurred in paediatric patients. Meanwhile, the paediatric population who experienced MEs was lower than that reported by Aseeri *et al*. (2020). Due to the different age categories being used by different studies, a comparison in occurrence by age cannot be done conclusively. The prevalence of MEs between males and females is comparable.

Most MEs were found to be near misses rather than actual errors that reach patients. The percentage of actual errors that reached patients was 2.6%. Other studies have reported a higher percentage of actual errors, ranging from 13.7%–30.7% (Ali *et al*. 2017; Aseeri *et al*. 2020; Samsiah *et al.* 2016). Most MEs occur in the inpatient setting, which was also found by Sheikh *et al.* (2016). Strom (2012) mentioned that the complexity of disease and drug regimens are among the reasons for MEs to be more susceptible to inpatients. The majority of the MEs were detected by pharmacists. Ali *et al*. (2017) and Samsiah *et al.* (2016) also reported the same finding. This is expected as pharmacists is the last healthcare provider seen by a patient or the last line in the process of supply of a prescription. Pharmacists who detected the MEs were able to intervene and prevent the errors from reaching patients.

From the results of this study and others, it was shown that pharmacists are important in preventing MEs. As the task and technology factors are the main contributors to medication errors pharmacists have made many improvements by addressing the system of medicine use. These include improvements in medicine labelling, providing guidelines and protocols for example, for drug dilutions and accepted abbreviations. Providing education on medication safety is one area that pharmacists continuously carry out at health institutions (Nguyen *et al*. 2015).

MEs can happen at any stage of the medication use process. In our analysis, the prescribing stage caused almost all of the MEs (97.4%) that occurred. A similar finding was also reported by other recent studies (Rishoej *et al.* 2017; Samsiah *et al*. 2016; Shehata, Sabri and Elmelegy 2016). In contrast, the study that was done by Aseeri *et al.* (2020) reported that MEs mostly occurred during the dispensing stage (36.7%) as compared to the prescribing stage (34.1%). Another study also reported a different finding whereby the administration stage was responsible for 97% of the overall reports (Cassidy *et al*. 2011). The contrasting result might be contributed by the difference in the categorisation of the administration stage. In the study by Cassidy *et al*. (2011), the types of errors such as wrong medication, wrong dose, wrong route or wrong time were categorised as administration errors and these errors collectively contributed to most of the reports. Unlike the study by Cassidy *et al.* (2011), our study classified administration error as any error that occurred during the actual process of administration only.

Reducing the occurrence of errors during the prescribing stage is crucial when this type of error was found to be the main contributor to all errors. An evidence-based study by de Araújo *et al.* (2019) outlined four preventive measures to reduce prescribing error: conduct educational programs for prescribers to develop skilful prescribing habits; the use of the computerised alert system for clinical care; implementation of computerised tools to guide the prescribing process and implementation of teamwork of a multidisciplinary team in patient care, especially the involvement of a pharmacist.

This study also showed that the prescribing of the wrong dose was the most common type of error. This finding is in line with other previous studies (Alba, Gutiérrez and Escobar 2015; Ali *et al*. 2017; Björkstén *et al*. 2016; Rishoej *et al*. 2017; Samsiah *et al*. 2016; Shehata, Sabri and Elmelegy 2016). Administration error was found to contribute to higher actual error compared to wrong dose error. The avoidance of administration error is very important as it is one of the errors that can cause serious harm including mortality (Härkänen *et al*. 2013).

Most of the MEs in this study were near misses, thereby not causing harm to the patients. Comparable results were also reported in other studies (Alba, Gutiérrez and Escobar 2015; Ali *et al*. 2017; Machado-Alba, Moncada and Moreno-Gutiérrez 2016; Rishoej *et al.* 2017; Samsiah *et al*. 2016; Shehata, Sabri and Elmelegy 2016; Sheikh *et al*. 2017). In our study, harm to the patient due to MEs was also significantly low. Previous studies showed that errors caused harm at a rate of 0.04%–13% (Ali *et al*. 2017; Machado-Alba, Moncada and Moreno-Gutiérrez 2016; Samsiah *et al*. 2016; Shehata, Sabri and Elmelegy 2016). Cases of death due to MEs are relatively low. Some studies reported no fatal cases, including this study.

The majority of drugs involved in MEs were cardiovascular system drugs, anti-infective for systemic use, drugs for the alimentary tract and metabolism, nervous system drugs and, blood and blood-forming agent. A similar study in Malaysia also reported that most of the MEs were associated with drugs for the cardiovascular system and anti-infectives for systemic use (Samsiah *et al*. 2016). Other studies reported that cardiovascular system drugs, anti-infective for systemic use, drugs for the alimentary tract and metabolism, nervous system drugs and, blood and blood-forming agents as the most frequent drugs that caused the error (Alba, Gutiérrez and Escobar 2015; Machado-Alba Moncada and Moreno-Gutiérrez 2016; Pawluk *et al.* 2017; Rishoej *et al*. 2017; Shehata, Sabri and Elmelegy 2016). The most common drugs involved in MEs were not the same for different studies as the drugs utilised in different countries and healthcare facilities differ. However, Rishoej *et al.* (2017) and Samsiah *et al.* (2016) in their studies reported a comparable finding with this study, where cefuroxime was among the common medicines involved in MEs.

The probable cause for these five groups of drugs to be significantly associated with MEs was due to their high utilisation in the hospitals. The Malaysian Statistics on Medicines also reported that these five drug classes were listed in the top 50 most utilised therapeutic drug groups in Malaysia from 2011 until 2014, and especially so for the cardiovascular system drug (Ministry of Health 2017). Some cardiovascular system drugs are listed as high alert medications. These medications can cause significant harm when associated with MEs.

Various factors led to MEs in this study. However, the most common factor that led to MEs were staff factors, and task and technology factors. Inexperienced personnel, inadequate knowledge and, failure to adhere to working procedures contributed more to the error as identified in other studies (Ali *et al.* 2017; Samsiah *et al*. 2016; Shehata, Sabri and Elmelegy 2016). MEs are more susceptible to occur in a healthcare facility with a weak medication management system and staff issues (World Health Organization 2018). Multiple interventions to reduce MEs have already been developed. They include implementation of technology-based processes such as computerised entry and bar-coding system and automated dispensing cabinet; standardising medication-use processes, performing medication reconciliation and, providing education and training (Weant, Bailey and Baker 2014). Implementation of this intervention varied among healthcare facilities.

The findings of this study provide a better understanding of the nature of MEs that occur in this tertiary healthcare facility. Targeted implementation of preventive strategies particularly for paediatric and geriatric patients can be undertaken to reduce and eliminate

MEs. This could include training and education to the personnel involved and improvement in the procedures of medication handling and administration. Studies that involved these disciplines can be conducted to determine if the intervention strategies are effective. While the reporting rates have significantly increased over the years since the establishment of MERS in 2016, health professionals in both the public and private sectors should be encouraged to report to the national reporting system.

### Limitations

This study was only focussed on analysing the medication error reports in a tertiary healthcare facility. The results of this study might only provide the characteristics of MEs of this type of healthcare facility and not the Malaysian public healthcare system as a whole. There was a large amount of data that were transcribed from the database at the HRPB to our database. The transcription of data was carried out by only one researcher. There is always a chance of error during data transcription.

The analysis carried out depends entirely on the data reported and recorded in the database at the HRPB. The drugs involved in MEs were not stratified by the administration route and complexity of the preparation procedure since this information is not available in the report form. Therefore, an in-depth study on the association of drugs involved in MEs with the dosage or administration route could not be performed. The unavailability of data on workload and working experience of the healthcare professionals limits further investigation of their relationship to commit an error.

## CONCLUSION

The main conclusion that can be drawn from this study is that most MEs are classified as near-misses. Actual errors that harm patients were also rare and most MEs occurred in warded patients. Geriatric patients were more susceptible to MEs while paediatric patients were the most vulnerable. MEs occurred at all stages of the medication use processes but mainly during the prescribing stage. However, actual errors are more likely to occur during drug administration. The most frequently reported error type was the wrong dose. The majority of MEs that occurred in this study caused no harm to patients. Most harm-related errors required immediate intervention and monitoring. The main healthcare provider that made ME reports were pharmacists.

Effective implementation of proper guidelines and existing preventive strategies would help in reducing and eliminating MEs, thus improving clinical practices and ensuring patients' safety. While reporting of MEs in Malaysia to MERS is voluntary, health professionals should be encouraged to report to the national reporting system.

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