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Medication errors among registered nurses in Jordan

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Abstract

Objectives Medication error (ME) is like a venom dispersing in clinical practice, particularly the process of drugs' administration. Nurses, as the direct drug administrators, are in critical defense lines to prevent its occurrence. Therefore, our aims were to explore nurses' understanding, perception, attitude and prevalence of MEs and thereafter defining the main factors associated with its occurrence and needed for designing proper policies for its sufficient prevention.

Methods Self-reported questionnaires were obtained from 156 nurses distributed almost equally between the 3 major teaching hospitals in Jordan. The questionnaires aimed at measuring their understanding, attitudes, and the prevalence of MEs.

Key findings The majority of respondents were males (51.3%), young (25–34, 75%), hold a BSc degree (84.6%). Most of their experiences were less than 5 years (67.3%). The level of understanding of the definition, associated factors, and the consequences of ME was acceptable between registered nurses in Jordanian teaching hospitals. Nurses who had the lowest experience (0–5 years) were the highest in committing MEs (P -value = 0.006). Otherwise, gender, age, and education were not significantly associated with MEs. The participants reported that the most common causes of medication error were setting the infusion devices incorrectly, distraction, labeling and packaging problems. Participants declared that the incidents of MEs are underreported (Reporting rate (28.3%)) and they believed that it was most likely due to the fear of losing their job, misjudgment on the seriousness of the incidence that warrant reporting, and fear from coworkers' actions.

Conclusions MEs are common and may be underreported among registered nurses in Jordan. National policymakers should take critical steps to encourage the nurses to report any error in medication administration and therefore reducing its occurrence.

Keywords drug administration; medication error; medication prescription; nursing; reporting of medication error

Introduction

A medication error (ME) is characterized and defined by the National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP) as any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient or consumer.^[1] Its measurement varies widely in clinical settings, and the main causes for divergence are due to differences in the definition of MEs, variation in numerator/denominator, how to compute error rates, documentation process and the culture of settings technologies.^[2–4]

Medication error is a universal challenge where 5% is fatal, and almost 50% is preventable with routine clinical settings.^[5] Each year, in the United States alone, 7000–9000 people die as a result of a ME.^[6] As specified by the Institute of Medicine (IOM), 400 000 cases of preventable patient injury because of MEs occur each year in emergency clinics in the USA. It is observed that 19% of MEs in the ICU are life-threatening and 42% are sufficient or clinically importance to warrant additional life-sustaining treatments.^[2,7] Besides, the total cost to manage patients with medication-associated errors exceeds \$40 billion each

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year.^[6] In agreement with that, MEs extend hospital stays by 2 days and increase the costs by \$2000–\$2500 per each patient.^[8,9]

Physicians are responsible for prescribing medications, and pharmacists are responsible for dispensing and storing medications while nurses are responsible for the last step of administering those medications. Therefore, all medical professionals can commit errors related to medication administration with nurses representing the final step in that cycle.^[10,11] Consequently, good nursing practice guaranteed the most efficient measures aiming to reduce the incidence of ME. In Jordan, two detecting methods of MEs (observation and chart review) revealed that MEs may occur mainly during the administration and transcription stages of the medication use process.^[12,13] Thus, nurses have critical roles around their activities to advance safety and anticipate damage to patients.^[14]

Jordan is a developing country that suffers from the shortage of resources, which may be related to nurses overflow outside the country due to the scarcity of the appropriate facilities and salaries that are provided to them.^[15] In turn, shortage of nursing professionals can cause an increase in their workload, less of the educational courses that they can participate in them, and concomitantly resulted in an increased risk of committing MEs.^[12] It is anticipated that controlling MEs can improve the health services and can reduce the healthcare costs. However, there are few published studies about this issue in Jordan.^[3,12,13,16] Overall, there is a need to improve the quality of reporting systems from Jordan and a standardized approach for the quantification of MEs' prevalence, severity, outcomes and contributory factors is warranted.^[17]

The main purpose for our study was to identify and understand the contribution of MEs from a nursing perspectives; thereafter, improvements can be implemented. We investigated nurses' recall of committing MEs, and the percentage of MEs that were reported to the nurse managers using incident reports. In addition, this study aimed at identifying causes of MEs and nurses' views on the reporting of these errors.

Material and methods

Study design and participants' selection

A cross-sectional study using self-reported questionnaires were obtained to explore various issues of MEs between registered nurses in Jordan. The study participants were registered nurses from the three major and officially teaching hospitals in Jordan (with international accreditations): King Abdulla University Hospital (KAUH), University of Jordan Hospital (UJH) and King Hussein Cancer Center (KHCC). Registered nurses with more than 1 year of in hospital experience, and hold at least a bachelor degree, were included in this study. This criterion was set to guarantee that the participated nurses were involved in the process of drug administration. Other healthcare providers such as pharmacists and physicians were excluded from participating in this study.

A convenient sample of 156 registered nurses filled the survey appropriately. The response rate was more than 40% and about 50 participants from each hospital were included within the final analysis of the study. After the survey was distributed to the participants, those who accepted to participate were asked to sign the study consent form. The participants were asked to drop the filled questionnaires in a nonattending collecting box at a general area in each hospital.

Instruments

The Modified Gladstone's scale with modifications was used to collect data on percentage, causes and reporting of MEs.^[3,18,19] This instrument measures: (1) percentage of MEs that are reported to the nurse managers (one item); (2) nurses' perceived causes of MEs (10 items); and (3) nurses' views about reporting MEs (six items). The participants' understanding about the concept of ME was also evaluated through general questions about the concept and by introducing some hypothetical drug administration scenarios.

To identify the most common causes of MEs, nurses were given a list of 10 possible causes and were asked to rank them on a scale ranged from 1 to 10, with 1 indicating least frequent cause and 10 indicating most frequent cause. To assess nurses' views about the process of MEs reporting, the percentage of MEs reported by nurses was obtained from them and the causes for under reporting were ranked in descending order.

Statistical analysis

Descriptive statistics of qualitative and quantitative variables were calculated. For qualitative variables, frequencies and percentages were calculated while for quantitative variables arithmetic means, standard deviations, medians, minimum and maximum values were given. To determine the statistical hypothesis testing methods, the distribution characteristics of the continuous data were investigated in terms of normality. For this purpose, Kolmogorov–Smirnov test of normality, Shapiro–Wilk test of normality, Q–Q plots, skewness and kurtosis values were all analysed. Using all gathered information, nonparametric hypothesis tests were performed throughout the whole data analysis phase. The Kruskal–Wallis test and the Mann–Whitney *U*-test were performed when applicable. For evaluating the associations between categorical variables, Pearson chi-square test and Fisher exact test were performed. Level of significance was accepted to be 0.05 for the whole study. All statistical calculations and analysis were performed with Statistical Package for Social Sciences (SPSS) 20.0 software, IBM, V21, (Chicago, IL, USA).

Results

Demographics and participants' characteristics

The males' respondents were 51.3% ($n = 80$), and the females were 48.7% ($n = 76$). The age distribution of the respondents showed that 75% ($n = 117$) of the nurses were

between 25 and 34 years old and 6% ($n = 15$) were between 35 and 44 years old (Table 1). Referring to the educational level of the enrolled participants, most of them had a bachelor (BSc) level of education (84.6%, $n = 132$), while the remaining had a master (MSc) degree as a higher education (14.1%, $n = 22$). Regarding the years of experience, most of the participants had <5 years of experience (67.3%, $n = 105$), while only 10.3% ($n = 16$) of the nurses had more than 10 years of experience. The questionnaires were distributed in three main hospitals in Jordan, KAUH, UJH and KHCC with a percentage of (32.7%, $n = 51$), (32.7%, $n = 51$) and (34.6%, $n = 54$) respectively (Table 1).

Rates of medication errors and its associated factors

The numbers of reported MEs among the participant nurses during their whole career were shown in (Table 2). The frequencies of using incidence reports have been divided into groups. Minimum value was 0 indicating of no reporting of any errors from nurses (six nurses), while maximum value was 90 and it was obtained from one nurse. The mean \pm SD was (28.3 ± 16.6) while the median was 25 error per whole career. The annual rate of reported errors from the participant nurses were shown in (Table 3). About 83.4% of the nurses reported <1 error/year; however, only six nurses reported more than 2 errors/year. The mean \pm SD of the annual reported errors among the study participants was (0.6467 ± 0.86118) with a median of 0.4167 error/year.

The associations between demographic characteristics including working hospitals and the annual rate of MEs

Table 2 The numbers of reported medication errors (ME) during the career of participants' nurses

Reported MEs	<i>n</i>	%
0 (never committed a ME)	6	3.8
0–10	16	10.3
11–20	41	26.3
21–30	49	31.4
31–40	21	13.5
41–50	9	5.8
51–60	8	5.1
61–70	3	1.9
71–80	2	1.3
81–90	0	0
91–100	1	0.6

Table 3 The annual rate of reported medication errors for the participants' nurses

Error rate	Frequency	Per cent
0–1	126	83.4
1–2	19	12.6
2–3	4	2.6
4–5	1	0.7
5–6	1	0.7

were shown in (Table 4). As expected, nurses who had the lowest experience (0–5 years) were the highest in committing MEs (P value = 0.006). Otherwise, the gender, age and education were not significantly associated with MEs. Moreover, nurses working at UJH were the highest of committing MEs and significantly higher (P value <0.05) than those working at the other hospitals (KAUH and KHCC).

Table 1 Demographics and characteristics of the study participants

Variables	<i>n</i>	%
Gender		
Male	80	51.3
Female	76	48.7
Age		
<25 years	23	14.7
25–34 years	117	75.0
35–44 years	15	9.6
45–54 years and above	1	0.6
Level of education		
Diploma	0	0
Baccalaureate	132	84.6
Master and above	22	14.1
Experience		
0–5 years	105	67.3
6–10 years	35	22.4
>10 years	16	10.3
Hospitals		
KAUH	51	32.7
UJH	51	32.7
KHCC	54	34.6

KAUH, King Abdulla University Hospital; UJH, University of Jordan Hospital; KHCC, King Hussein Cancer Center.

Table 4 The associations between participants' characteristics and rates of medication errors

Demographic characteristics	Mean \pm SD	Median (Min–Max)	<i>P</i> -value
Gender			
Female	0.6293 \pm 1.01975	0.3333 (0–6)	0.812
Male	0.6626 \pm 0.69186	0.5278 (0–3)	
Age			
<25	0.9015 \pm 1.09068	0.75 (0–3.33)	0.173
25–34	0.6344 \pm 0.84169	0.5 (0–6)	
>35	0.3682 \pm 0.51181	0.2143 (0–2)	
Experience			
0–5	0.8009 \pm 0.98887	0.5 (0–6)	0.006
6–10	0.3742 \pm 0.40266	0.2857 (0–2)	
>10	0.26 \pm 0.26276	0.1905 (0–0.69)	
Education			
BSc	0.6367 \pm 0.90109	0.3333 (0–6)	0.727
MSc	0.7063 \pm 0.58079	0.6458 (0–2)	
Working hospitals			
UJH	0.9435 \pm 0.7793	1 (0–3.33)	0.0098
KAUH	0.4882 \pm 0.5867	0.33 (0–3)	
KHCC	0.5087 \pm 1.073	0.23 (0–6)	

Nurses' perception on the concept of medication error

The nurses were asked about some hypothetical scenarios related to drugs' administration and whether they believed that they represented ME, they need to be notified to the physician, and/or it is necessary to write an incidence report about them (Table 5). In general, the participants' nurses showed good knowledge and positive perception about the concept of ME.

Most common causes of medication errors

Ten possible causes of ME were listed, and the participants' nurses were asked to rank them based on their prevalence (Table 6). The main causes were being nurses setting the infusion device incorrectly (6.36 ± 2.62), distraction by other patients, coworkers or any event (5.9 ± 2.9), labelling and packaging errors (5.85 ± 2.85). On the other hand, tiredness and exhaustion were the least possible cause (3.91 ± 2.94).

Nurses' views about reporting the medication errors

Nurses' views upon reporting of MEs have been also evaluated in this study. Our study showed that the most common reasons of ME underreporting were being afraid of losing the job (1.78 ± 0.41), nurses did not think the error was serious to warrant reporting (1.63 ± 0.48), and being afraid from coworkers' actions (1.34 ± 0.47). However, nurses' knowledge about constitution of MEs, and ME reporting using incidence reports were considered to be low (1.18 ± 0.385 and 1.10 ± 0.296 respectively (Table 7).

Discussion

MEs are considered important contributors to the obstacles that can face the healthcare systems. Nurses may play a major role in controlling those errors. However, more direct

Table 6 Causes of medication errors (MEs)

Causes of MEs	X	SD
MEs occur when the nurse sets up or adjusts an infusion device incorrectly	6.36	2.62
Distraction by other patients, coworkers or events on the unit	5.90	2.90
MEs occur when the medication labels/packaging are of poor quality or damaged	5.85	2.85
MEs occur when the nurse miscalculation the dose	5.54	2.66
MEs occur when the nurse fails to check the patients name band with the medication administration record (MAR)	5.42	3.59
MEs occur when nurses are confused by different types and functions of infusion devices	5.38	2.71
MEs occur when there is confusion between two medications with similar names	5.17	2.47
MEs occur when the physicians writing on doctors order form is difficult to read or illegible	5.15	2.85
MEs occur when the physician prescribe the wrong dose	5.01	2.93
MEs occur when nurses are tired and exhausted	3.91	2.94

and focused work with clear vision at the main contributing factors is needed to improve patient safety and reduce hospitalization stay and costs because of MEs. This study of sampled registered nurses, from the three major teaching hospitals in Jordan, showed that there is a significant association between experience and MEs. This result was in consistent with previous studies where they found that insufficient work experience was significantly associated with the increase rate of MEs.^[20,21] On the other hand, our study showed that gender, education and age were not associated significantly with MEs.

To fulfil the objective of determining the causes of MEs, ten factors were evaluated as possible causes. The highest three factors that contributed to MEs are as follows: firstly, setting the infusion devices incorrectly. Secondly, distractions by other patients, coworkers or any event. Thirdly, labelling/packaging problems.

MEs while using the intravenous (IV) route of administration were reported very frequently and maybe accounted

Table 5 Nurses' perception of medication errors (the respondents can pick more than one answer)

Question	Drug error	Notify Physician	Incident report necessary
A patient misses his midday dose of oral ampicillin because he was in X-ray for 3 h	88 (57%)	136 (87.8%)	89 (58.4%)
Four patients on busy surgical unit receive their 6:00 p.m. doses of IV antibiotics 4 h late	124 (80.8%)	135 (86.5%)	99 (64.8%)
A patient receiving TPN feeding via infusion pump is given 200 ml/h instead of the correct rate of 125 ml/ml for the first 3 h of the 24-h infusion. The pump was reset to the correct rate after the change of shift at 7:00 a.m. when the oncoming nurse realized that the pump was set at the incorrect rate	141 (91%)	144 (92.9%)	130 (83.9%)
A patient admitted with status asthmaticus on 08/13/97 at 2.00 a.m. is prescribed Ventolin nebulizers every 4 h. The nurse omits the 6:00 a.m. dose on 08/13/97 as the patient is a sleep	91 (58.3%)	120 (77.5%)	82 (53.2%)
A physician orders Percocet 1-2 tabs for post-op pain every 4 h. At 4:00 p.m., the patient complains of pain, requests one pill and is medicated. At 6:30 p.m., the patient requests the second pain pill. The nurse administers the pill	104 (67.3%)	120 (77.5%)	89 (59%)
A patient is receiving a routine 9 a.m. dose of digoxin every day. Yesterday's digoxin level was 1.8 (the high side of normal). A digoxin level was drawn at 6 a.m. today. At 9 a.m., the nurse holds the digoxin because the laboratory value is not available yet	64 (41%)	103 (66%)	62 (39.7%)

Table 7 Nurses views upon reporting of medication errors (MEs)

Views on reporting MEs	X	SD
Nurses failed to report a ME because they were afraid that they might be subject to disciplinary action or even lose their job	1.78	0.41
Nurses failed to report a ME because they did not think the error was serious to warrant reporting	1.63	0.48
Nurses did not report MEs because nurses are afraid of the reaction they will receive from their coworkers	1.34	0.47
Nurses did not report MEs because nurses are afraid of the reaction they will receive from the nurse manager	1.24	0.43
Nurses were usually sure when MEs should be reported using incident reports	1.10	0.296
Nurses were usually sure what constitutes a ME	1.18	0.385

for at least 9.4% of MEs.^[22–26] Inappropriate setting of infusion devices mainly because of miscalculation of concentrations or rates, an error in drawing up solutions, incorrect settings of the pump, documentation errors, or confusion of intravenous lines, were frequently reported as MEs.^[9,20,27–29] Furthermore, any accidental connection between different types of tubing such as epidural IV tubing or epigastric one can cause serious harm for the patients.^[30] Documentation errors can possibly be the main reasons while compatibility and administration errors accounted to a lesser extent because of providing support for compounding and administering therapies (compatibility, IV dosing charts and guidelines).^[31] As a result, intravenous administration accounted for more severe errors than any other route of administration possibly due to skill and knowledge deficiencies.^[32] Moreover, the failure of following drug policies, and patient checking might trigger MEs.^[29] Therefore, it is recommended to have an independent double-check protocols for calculation and identifying allergies, ensuring patient awareness of the drug and using a bar-code assisted medication administration process to ensure patient safety.^[30] Moreover, properly trained nurses after obtaining sufficient educational programs about reviewing, preparing, dispensing and monitoring systems are needed with the importance of correctly applying the five rights, metric equivalent, basic dosage/rate calculations and documentation in competency files.^[30] Although some nurses might fail to check patient identity using medication administration record (MAR) which caused an error,^[33] however, MEs were reduced when this technique was applied.^[34] In agreement with that, it was reported that 14.3% of errors were due to incorrect or incomplete documentation which consisted of incomplete labelling of IV infusion bags or tubing and incomplete documentation in MAR.^[31] Thus, it is recommended, when setting infusion devices, to always follow inevitable steps.^[35–37]

As mentioned earlier, the second contributing cause of MEs were distraction and interruption. Some reports indicated that interruption and distraction among nurses during preparation and administration may be accounted for the highest number of MEs (the number of errors was tripled once nurse interrupted six times).^[38,39] Therefore, it is better to understand how interruptions can affect the clinical

settings and how it was initiated, to create effective protective strategies to be implemented such as providing isolated area during preparation or injection, ensuring no disturbance or interruption, managing mobile devices, alerts, alarms and noises, provision of supplies before prescribing, preparing or administration.^[40,41] Another suggestion was to use a sterile cockpit rule for the elimination of distractions during medication preparation by providing a sign such as 'do not disturb' or 'quiet zone'.^[42] It is worth mentioning that the rate of MEs was reduced by about 42.78% when this strategy was implemented.^[42]

As mentioned previously, the third factor that leads to MEs was labelling problems and damaged packages.^[29,43] The problems in labelling or packaging can cause MEs because of the difficulty in reading and understanding the medication identity and its recommendation for use or administration.^[44] Medication labelling is a useful link between health professionals and patients. Thus, it provides clear and complete information so that healthcare professionals have the essential information needed to make informed decisions and to facilitate safe and effective use of a medication.^[45] Therefore, it is suggested to improve the labelling and packaging format to ease the readability, understanding and medication use through using of larger fonts, lists, headers and white space, and by using simple language and logical organization. The prescriptions should be incorporated with the software used by dispensing pharmacies, making filling and printing the labels easily obtained.^[46] This technique can provide another level of quality assurance.^[44]

There are other factors that were found to be less associated with MEs but still contribute to them, for instance: miscalculation of the dose has a role in MEs due to the lack of pharmacological backgrounds and math skills.^[28,47,48] Patient identity is another factor that causes MEs especially when the nurses fail to check the patient's name band in accordance with the medication administration record (MAR).^[33] Furthermore, lack of awareness of drug name, purpose and side effects were triggering MEs because of insufficient knowledge and pharmacological training.^[9] Consequently, wrong time, dose, medication or even not giving the medication at all were all contributing factors for MEs.^[49–53] In agreement with that, another study from Jordan stated that workload, wrong time (30.5%), wrong patient (30.5%) and night shifts (42.9%) were main reasons for MEs.^[13] In addition to that, previous studies reported that failure of communication between personnel (physician handwriting which may be hard to read, use of medical abbreviation and verbal command) were also contributing to MEs.^[19,20,29]

On the other hand, reporting of MEs could be one of the hurdles that can be continuously faced in the clinical settings. In our study, we found that the main reasons for the underreporting of MEs are fearing from losing the job, nurse's unseriousness about the errors that warrant reporting, and fearing from managers and coworkers. In agreement with that, previous studies showed that the fear from reporting and the difficulties faced in the reporting process were the main causes of MEs' underreporting.^[54–57] Saying that, 16% of the nurses may not realize the definition of

ME and about 14% of them may not recognize when to formally document it or report it.^[50] This was also found with nurses from Jordan.^[3] Furthermore, some reports indicated that 44.4% of nurses are fearing from serious consequences such as loosing patient's trust and legal consequences.^[58] As well, organizational barriers, cultural blaming, managerial impact and unhelpful reporting-feedback systems could affect the reporting behaviours of nurses and may hinder the validity of the reporting process.^[59] Moreover, it is worth mentioning that even heavy workload might prevent proper and immediate reporting of MEs.^[50] Hence, immediate reporting has a lot of advantages, such as improving the management of the patient after the error, and getting a timely medical advice and an immediate counselling.^[3,18,19,55,60] Moreover, it is strongly recommended to improve communication skills and build-up trust among healthcare providers of how to cope with the resulting stress out of committing MEs.

While the rate of MEs' reporting in Jordan^[3] and the United States^[19] was 42.1 and 45.6%, respectively, in the current study, the rate of reported MEs was less than that and approximately about 28.3 %. One of the expected explanations is the underreporting because of the hospitals policies, since the mandatory reporting systems are focusing on the punishment of the healthcare provider which could demolish the trust between them and their organization. Alternatively, voluntary reporting systems are confidential, trusty and nonpunitive where those systems are focusing on safety as priority. Therefore, reporters will narrate the whole story with no fear. Consequently, the voluntary systems may be more successful in providing useful information about MEs, their causes and can suggest valuable strategies to prevent their occurrence in the future. As a result, voluntary systems can improve the therapeutic responses, nurses' knowledge and could identify the manufactures about labelling, packaging, safety issues for a better delivery system. Moreover, it can provide broader immunity with nonpunitive culture that places higher value on resolving system-based problems rather than punishments. Hence, reporting should be accompanied by effective timely system changes by accrediting bodies and regulatory agencies and it is managed by an independent expert to figure out the causes and improve safety.^[61,62] Finally, it is important to keep in mind that it is hard to generalize those results with the lack of standard methods for measuring the MEs, since any violation of hospital policy could lead to errors.^[22] Thus, parallelism with extensive studies should be taken in all hospitals to look up the different sources of errors and accordingly providing sufficient recommendations to reduce them to the lowest possible level along with spreading the awareness of the importance of errors reporting.^[9] Those strategies can help in overcoming other barriers such as cultural criticism and lack of peer review protection.^[63] As well, training courses on the proper and safe use of different medications are periodically needed to reduce the frequency of MEs.^[50,58]

Conclusion

Medication error are common and may be underreported among registered nurses in Jordan. National policymakers

should take critical steps to encourage the nurses reporting of any error in medication administration and therefore reducing its occurrence.

Declarations

Conflict of interest

The Author(s) declare(s) that they have no conflicts of interest to disclose.

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Authors' contributions

NA, Rabia H. and Razan H. initiated and designed the study. Rabia H, Razan H, and TM collected the questionnaires. NA, SS, DA, and SA participated in the analyses of the data. NA, SS, Razan H, and DA formulated the first draft of the manuscript. NA, Razan H, TM, DA, and SA critically reviewed the final manuscript.

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