Original Research

Understanding the Nature, Contributing Factors, and Corrective Actions of Medication Administration Errors: Insights from Saudi Arabia

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Abstract

Background: Medication errors continue to be a global patient safety concern as they are associated with a negative impact on morbidity and mortality and health-care costs. Research in Middle Eastern countries has been limited and focused on reporting on the incidence, type, and contributing factors with limited knowledge on the preventability and severity of medication errors and the corrective action taken from the reported medication errors. **Materials and Methods:** A retrospective, descriptive study design was used with selected clinical units in one hospital in the Middle East to gain insight into the incidence, type, location, level of severity, and causes of medication administration errors (MAEs) and the corrective actions taken. Data collected between February 17, 2014 and August 30, 2015, in the organization's reporting system were analyzed using descriptive statistics. **Results:** The most frequent types of MAEs reported were delayed administration (23%) and wrong dose (15%), occurring in the clinical units (65%), ambulatory settings (18%), the pediatric children cancer center (11%), and the surgery division (3%). The majority of MAEs were rated as no harm (184 errors, 69%) followed by temporary harm (80 errors, 30%), with two incidents with pediatric patients resulting in permanent functional harm and one incident with a pediatric patient resulting in death. The majority of factors contributing to the MAEs involved staff factors including failure to follow policies and procedures (86%) followed by inadequate communication (17%). The most common corrective action was no action (30%) followed by counseling the staff involved in the MAE (29%), sharing at a unit or departmental meeting (25%), and training and educating the staff (15%) as a result of the error. **Conclusion:** Our study results delineated the nature, contributing factors, and corrective actions taken associated with reported MAEs. Future research is required to examine and explore the nature of MAEs, contributing factors, corrective actions taken, and exploration and examination of the impact of efforts to enhance MAE reporting and learning systems in hospitals.

Keywords: Contributing factors, medication administration errors, patient safety

Introduction

Over the past two decades, patient safety has become a priority and fundamental cornerstone for health-care providers, administrators, and policy makers globally.[1-3] Of particular concern is that patients continue to experience adverse events caused by hospital care, resulting in serious clinical consequences for patients[4] and an economic burden on the system.[1,5,6] Within the adverse event taxonomy, medication errors are the most preventable[7,8] and the most frequent.[2,9,10] Further, medication errors have been in the Joint Commission on Accreditation of Healthcare Organization's top 10 list for the most frequently reviewed sentinel events for the last 4 years.[11] Medication errors often occur at the prescribing stage of medication[2,12-14] or administering

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stage of medication.[15-18] For example, a systematic review conducted in the Middle Eastern countries reported 7.1%–90.5% medication errors associated with prescribing the medication and 9.4%–80% medication errors associated with administering the medication.[4]

Medication errors can have a negative impact on morbidity and mortality and can result in increased length of stay and costs.[1,7,19] Thus, medication errors are often used as a barometer of patient safety in health-care organizations and by policy makers.[2,20] One of the key data sources that the health-care organizations use to monitor medication errors is the reports collected through their respective voluntary incident reporting systems.[21,22] Voluntary incident reporting systems enable data to be collected, aggregated, and synthesized to determine patterns that may lead to corrective action[23] and they are a requirement of several national accreditation bodies in the United States,[24] Canada,[25] and the Central Board of Healthcare Institution.[26] Proactively managing medication errors include reporting existing medication errors and providing an opportunity to identify and correct the errors that threaten patient safety by communicating and sharing the knowledge and learnings from the reported medication errors.[2]

Although learning from reported medication errors is acknowledged as a key to ensuring patient safety, the focus of research to date has not been on how or to what extent voluntary reporting systems can yield appropriate learning at individual and organizational levels.[27] Research has indicated that insufficient information about the nature and incidence of adverse events has hindered the development of preventative strategies to improve safety.[22,28] For example, research efforts in countries in the Middle East have been limited and focused on reporting on the incidence, type, and contributing factors and to a lesser extent on the preventability and severity of medication errors.[4,14,28] Further, there is limited knowledge around the corrective action taken from the reported medication errors in Middle Eastern countries.[4] Clearly research efforts are required to increase the understanding of the nature and the contributing factors of medication errors in Saudi hospitals[29] and the corrective actions taken.[30,31] In this context, a study was undertaken to quantify the incidence, types, location, level of severity, contributing factors, and actions taken to prevent recurrence of medication administration errors (MAEs) at a hospital in Riyadh, Kingdom of Saudi Arabia.

Materials and Methods

Design and setting

A retrospective, descriptive study design was used to gain insight into the incidence, type, location, level of severity, and causes of MAEs and the corrective actions taken in one hospital in Riyadh, Kingdom of Saudi Arabia. The hospital and research center is a 936-bed tertiary referral hospital consisting of 18 medical departments that provide services for various patient groups. The study was approved by the office of research affair and the hospital administration.

All medication orders must be prescribed through the Integrated Clinical Information System, verified by pharmacy services and signed electronically by an administrative nurse. MAEs can be reported through a voluntary, anonymous, and confidential reporting system known as the Quality Information System (QIS). The reported incident must include a brief description, the patient/s medical record number involved, the drug or drugs involved, and any possible contributing factors. On the basis of severity and location of the incident, the QIS sends a notification to the manager, medication safety officer, and quality department staff who then take the appropriate action, which is documented in free text accordingly. Specifically, the manager reviews and analyzes each incident and indicates in their progress notes what actions were taken to reduce the likelihood of recurrence and what stakeholders are required to address the action. The quality management staff review all corrective actions taken for their appropriateness and implementation.

Medication administration errors definitions

Medication errors can happen during any stage of the medication process, including prescribing, order communication, product labeling, packaging and nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and use.[32,33] Errors that occur during the administration of medication include the wrong route, wrong or delay (±60 min) of time delivery, unordered drug, unordered dose, omission of dose, and lack of identity control.[18] For the purpose of this study, the following definition was used to classify MAEs[34]: "a deviation from the prescriber's medication order as written on the patient's chart (paper-based or electronic), manufacturers' preparation/administration instructions, or relevant institutional policies." MAEs also included ward level medication dispensing/preparation errors but excluded prescribing and pharmacy dispensing errors.

Data collection and analysis

The quality department staff and medication safety officer retrieved and screened medication administration incidents reported in all hospital units and clinics between February 17, 2014 and August 30, 2015, in the QIS for eligibility. Incidents that were duplicate in nature and adverse drug reactions were excluded from the study. The nature of the MAEs was analyzed using preset criteria that included not being an adverse drug reaction or a duplicate. Further, incidents when the nurse administered a wrong prescription that was prepared for the patient not

by the nurse were excluded. Descriptive statistics were used for the QIS MAEs dataset, and results were presented in frequency counts and percentages on the incidence, types, locations, level of severity, and contributing factors of MAEs. The contributing factors and sub-factors were mandatory fields in the QIS. Corrective actions for MAEs were reviewed and analyzed by quality professionals from different backgrounds (consultant, pharmacist, nurse, and laboratory technologist). The software used for reporting medication errors and data analysis was Datix Solution (DatixWeb version 14.0.35.1, Datix Ltd).

Results

Incidence, type, location, and level of severity of medication administration errors

During the study period, 297 MAEs were reported in the QIS. Of these, 267 (90%) met the inclusive criteria and the study's definition of MAEs. Initially, the frequency of reporting remained fairly constant from February 2014 to August 2014, with an average of 11 reported incidents per month. However, there was an increase in the frequency of reporting to an average of close to 18 reports per month for the remaining 12 months studied. Figure 1 provides the MAEs reported by month and year from February 2014 to August 2015.

The most frequent types of MAEs reported were omission that included delayed administration (23%) and wrong dose (15%). Some of the MAEs were classified by more than one type of error. Table 1 provides the frequency of MAEs by type of error.

There was a variation in the location of MAEs with the majority of errors reported occurring in the clinical units (65%), ambulatory settings (e.g., clinics and procedure rooms) (18%), the pediatric children cancer center (11%), and the surgery division (3%). Further, the general pediatric unit accounted for 44% of errors, followed by adult units at 32%, and units serving both adult and pediatrics at 24%. The majority of MAEs were rated as no harm (184 errors or 69%) followed by temporary harm (80 errors or 30%), with two incidents with pediatric patients that resulted in permanent functional harm and one incident with a pediatric patient that resulted in death.

Contributing factors

The majority of factors contributing to the MAEs involved staff factors (86%). Staff factors that emerged included failure to follow Internal Policies and Procedures, inappropriate or not checking the procedure, and inadequate assessment. Staff involved in the reported MAEs also reported being influenced by local working conditions and the surrounding environment including heavy workloads and distractions during daily practice. The second most common contributing factor to MAEs was communication (17%) and included ineffective staff-to-staff communication, incomplete, or inaccurate or ambiguous information provided. Education and training were cited as the third most common contributing factor accounting for 10% errors, including lack of knowledge and the length of experience. Table 2 provides the complete list of contributing factors to MAEs

Corrective action

A variety of corrective actions emerged including the most common actions as no action (30%), counseling the staff involved in the MAEs (29%), sharing at a unit

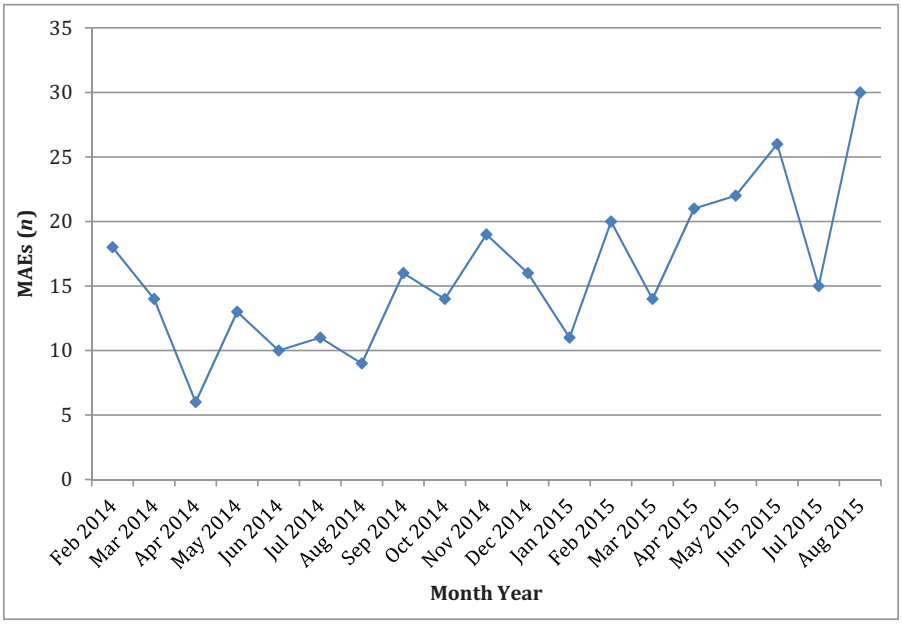

Figure 1: Monthly reports of medication administration errors (MAEs) during the study period.

Table 1: Medication administration errors by type

Type of administration error	*N*	Frequency
Omission (including delayed administration)	74	23%
Wrong dose	48	15%
Other	30	9%
Wrong rate	17	5%
Wrong patient	16	5%
Duplication/extra dose	16	5%
Wrong time	10	3%
Wasted medication	10	3%
Expired medication	9	3%
Wrong route	9	3%

Table 2: Contributing factors to medication administration errors

Contributing factor	*N*	Frequency*
Staff factors	229	86%
Ineffective communication (ambiguous communication)	45	17%
Lack of education and training	26	10%
Patient factors	24	9%
Equipment/supplies/medication	18	7%
Task factors	15	6%
Organizational management	6	2%
Team factors (role confusion, conflict between team)	6	2%
Other	5	2%
Work environment factors	3	1%
Total	377	

*Values calculated based on $n = 267$, which represents the total number of errors that met inclusion criteria for the study

Table 3: Corrective actions taken in response to medication administration errors

Type of corrective action	*N*	Frequency*
No action taken/not documented	82	31%
Counseling the involved staff	77	29%
Sharing at unit/departmental meeting	66	25%
Training/educating staff	41	15%
Reflective practice review	34	13%
Environment redesign	12	4.5%
Increase supervision	12	4.5%
Policy/procedure/guideline development or review	12	4.5%
Communication process enhanced	9	3.4%
Improve handover techniques	8	3.0%
Disciplinary	7	2.6%
IPP reinforcement	7	2.6%
Family education	6	2.25%
System enhancement	4	1.5%
Checklist development	1	0.4%
Total	378	

*Values calculated based on $n = 267$, which represents the total number of errors that met inclusion criteria for the study, IPP: Internal Policy and Procedure.

or departmental meeting where safety concerns were shared at daily huddles (25%), and training and educating the staff (15%) as a result of the error. Table 3 provides a complete list of corrective actions taken as a result of the error.

Discussion

Our study adds to the small but evolving literature associated with the nature of and contributing factors to MAEs in Saudi Arabia and the Middle East. In addition, this study provides insights into the corrective actions taken in response to the reported MAEs to prevent recurrence of similar incidents in the future.

The results around the increase in reporting may be a result of efforts of promoting a safety culture with a focus on enhancing the reporting of MAEs in the hospital's QIS. However, underreporting of MAEs and other types of safety incidents is well established both within the Middle East[4,29,35-39] and globally,[2,40] with omissions, delayed administration,[41-43] and wrong dose[34,44] being the most frequently reported MAEs. Further, similar to other literature, the location of MAEs often occurred in intensive care units (ICU) and medical units.[16,28,45,46] The results of this study may be partially due to the greater frequency of medications being administered in the medical units compared to that in the ambulatory units. Further, underreporting of errors in surgery may offer another explanation as this underreporting by physicians has been reported elsewhere.[2,47,48]

Of particular concern are the results around the frequency, and the highest level of severity of harm was associated with MAEs reported of occurring in the pediatric units. Similar to other studies, the majority of MAEs resulted in no or minimal harm.[7,16,28,49] However, a recent study conducted revealed that over half of the adverse drug events were significant (52.7%), with 37.1% being serious, 9% life-threatening, and 3% fatal.[28]

Study results delineated that staff factors contributing to MAEs (e.g., staff not following policies and procedures[14,42] and heavy workloads[27]) are similar to other results in the literature. This study also elucidated inadequate assessment as contributing to MAEs. The second most common factor contributing to MAEs, ineffective communication, also echoes other studies that have reported miscommunication, including between health-care providers[3,27,34,37,42] and patients and inadequate records.[3] For example, in one study, causes attributed to communication and information (errors involving misunderstanding during handovers and insufficiently explicit information/communication) represented 20% of the 448 causes.[27] Lack of knowledge and education, identified as the third most common reported factor contributing to MAEs, has also been reported by others,

including knowledge deficits due to lack of education, training, and experience.[4,43,49]

The finding of this study that in more than one-third of the MAEs no action was taken is similar to other literature.[43,50] For example, one study reported 53% and 58% of no action to errors in both ICU and non-ICU settings, respectively.[43] Our study results, regarding informing, counseling, and educating the staff members who made the MAEs, are also consistent with that of the literature in other countries.[27,43,51] In one recent study, the provision of information at a staff meeting in the department where the incident occurred (25%), provision of formal education to staff members in the department (15%), and dialogue with the staff member or staff members involved (7%) were among the most commonly pursued types of corrective action.[27] However, this study also reported a change in work routine or guideline as the most commonly pursued corrective action (53%)[27] compared to our study results of policy/procedure/guideline (4.5%) and checklist (0.4%) development or revision with environmental redesign (4.5%).

Although ineffective communication was the second most frequent contributing factor to MAEs (17%), the number of reported corrective actions taken were only 3.4% ($n = 9$) and 3.0% ($n = 8$) for enhancing communication and improving handover techniques, respectively. Given the importance of clinicians' understanding of the necessary information to share between teams and services, particularly during handover or transitions points, to ensure safe medication administration practices, warrants further attention.[41]

Collectively, the low reporting rate and higher percentage of no action taken with learnings mainly intradepartmental (e.g., individuals involved in MAEs, staff meetings) as a response to reported MAEs highlight the need to continue efforts to enhance MAE reporting and learning systems in hospitals. These efforts will require hospitals to leverage both single- (e.g., modification to work routines and guidelines) and double-loop (e.g., questioning and modifying the values, norms, and assumptions that underlie the goals and strategies) learning.[27,52] Further, leadership is required to continuously promote an open error reporting culture for the safety and benefit of patients and staff.[3] This will require leaders to shift the goal of incident reporting systems from solving specific safety issues to improving the process of learning.[53,54] In this context, MAE reporting systems need to be viewed as a platform to learn lessons that will help to prevent harm or the recurrence of similar events in the future.[2]

Study results point to future research that investigates the following: (1) rate of MAEs in the hospital and benchmark it locally and globally, (2) relationship between the contributing factors and the actions taken of errors, (3) variability of MAEs in pediatric versus adult units, and (4) exploration and examination of the impact of efforts to enhance MAE reporting and learning systems in hospitals.

Limitations

First, our results are a retrospective review of reports from a voluntary incident reporting system, which detects only a small fraction of errors as underreporting was a well-known issue and was highlighted several times locally and globally in the literature. Second, there may be issues related to the validity and reliability of the data because of the nature of voluntary and anonymous based reporting. Future research should explore multiple methods. Third, the number of error reports was also relatively small, which could be higher if the study was based on chart review or direct observations.

Conclusion

Our study revealed that not following procedure to accurately assess the patient, ineffective communication, and lack of knowledge and expertise were the most common contributing factors to MAEs. A key contribution of this study was the delineation of the types of corrective action taken as a result of MAEs that were predominately single-loop learning with staff members and clinical areas involved in the MAEs (e.g., counseling, educating, and sharing at the unit level). Moving forward, to address the underreporting and lack of corrective actions taken in response to MAEs, hospitals need to shift the current focus on reporting events and documenting corrective actions to determining, implementing, and evaluating appropriate corrective actions.[54,55] Future research is required to examine and explore the nature of MAEs, contributing factors, corrective actions taken, and exploration and examination of the impact of efforts to enhance MAE reporting and learning systems in hospitals.

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Conflicts of interest

The authors disclosed no conflicts of interest related to this article.

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